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SOIL EROSION: THE GROWTH OF THE DESERT IN AFRICA AND ELSEWHERE

Being a summary of an evening discourse delivered at the Royal Institution on November 12, 1937

BY

SIR DANIEL HALL, K.C.B., F.R.S.

[In view of the great importance of this subject in many cotton-growing countries of the Empire we are extremely indebted to Sir Daniel Hall for his kindness in allowing us to prepare and publish a summary of his recent lecture.—ED.]

IT is a commonplace of geology that the surface of the earth is constantly in motion; that our mountain ranges have taken shape and our river courses and valleys have been excavated by rain, frost and wind. In many parts of the world this movement of the soil surface is taking place rapidly, with serious consequences to the agriculture of those countries, owing to soil erosion.

The soil is dependent for its stability on its normal covering of vegetation, but as a rule the soil proper is not more than 6 inches to a foot deep, and it is in the surface layer that the fertility resides. There is thus always a danger that if the cover of vegetation is removed, the soil itself may shift under the action of either wind or rain. The earliest cases of erosion caused by such movement of the soil are those which follow deforestation in regions where the mountains in which the rivers take their rise are below the permanent snow line—*e.g.*, in the eastern Mediterranean. There is no evidence in support of the belief that forests increase the rainfall of a country; indeed, by the transpiration from their leaves, they must reduce the total amount of the rainfall retained by the soil, but they serve as its regulator; as the rain falls, it is absorbed by the spongy soil below the trees, rich in humus, and reappears later in the springs and rivers when the rainy season is over. Too commonly, however, the forests have been cut down without regard to their regeneration,

both for the value of their timber and for a desire to extend the grazing land.

The grazing animals themselves do further damage, especially if they are goats: not only do they destroy every seedling tree, but they tread hard paths down which the rain runs with gathering volume and increasing velocity, gradually forming gullies, until in a generation or two the hillsides get bared down to the hard, infertile subsoil. Nor does the damage end there. The rainfall, running off without a check, develops into a torrent and eats into the meadows bordering on its course. The earth that has been torn away is carried down to the plains, where it is deposited, and turns the river into a chain of malarious swamps. Similar phenomena can be seen in the new countries opened up in the nineteenth century: forests were destroyed, and rivers have become subject to violent flooding.

Another form of soil erosion which is perhaps even more spectacular is that exhibited by the vast duststorms, such as those which in 1934 swept over the United States east of the Mississippi. In Canada also wind erosion has occurred on a disastrous scale. The causes are easy to discern. This form of erosion occurs only in comparatively arid districts with an annual rainfall below 20 inches, and usually where the fundamental subsoil is of a sandy type. In America, before white settlement, these regions were covered with grass: some of the land was good grazing, with a fair depth of rich soil, but in the drier parts the sod was thin and there were only a few inches of soil. At first this poorer land was kept for grazing, but when the price of cereals rose rapidly from 1917 onwards farmers began to extend to them the area under plough. The system of farming was of a wasteful type; the straw was burnt, no stock was kept, and very few years with no recuperative crop were enough to exhaust the limited stock of humus. When years of drought came, the light soil, no longer bound together by either vegetation or humus, began to drift in the fierce winds that sweep over those great plains. The plough had destroyed the binding power of the soil, and the whole of the fertile top layer was swept away.

The methods practised by the pioneers in the development of a new country are rarely those of sound agriculture, but merely a form of shifting cultivation. Many European soils have been cultivated for a thousand years or more without showing any decrease in production, by the application of sound agricultural practice, while in China intensive cultivation has been maintained perhaps for four thousand years without soil erosion or loss of fertility.

In recent years where the danger of soil drifting is acute, means of cultivation have been introduced to minimize the risk. In some places the land has been divided into strips, bare land alternating with land under crop, in place of the former large areas under the same treatment. Incipient soil erosion through wind is in this way checked before it can proceed far. Another practice is to establish shelter belts to break the winds, though in some of the districts where wind erosion is worse—such as Saskatchewan and Alberta—it is no easy matter to find species that will stand up to the extremes of climate.

Erosion through wind, as described above, is worst on the flat plains, but erosion by rain is more common where the cultivated land is on a slope. In such parts the danger does not lie in a large annual rainfall, for that will as a rule generate a forest vegetation which protects the soil; it is the sudden heavy rainfall which causes most damage. Cultivated land on a slope may suffer from erosion by water of two kinds: (*a*) a continuous slow removal of the good soil (sheet erosion), and (*b*) a catastrophic wash-out (gullying). As preventive measures the slopes can be terraced and cultivated along the contours. The object of this is to enable the soil to absorb the rain as it falls without allowing it to set up a flow over the surface, but it may be necessary to break the terraces at intervals with spillways to lead accumulated water into drains or watercourses. Alternatively, belts of unploughed vegetation may be left to break a run-off. By such means, coupled with the growth of a leguminous plant which can be dug in to add nitrogen and humus to the soil, planters in tropical countries have been able to check erosion even where the rainfall is excessive. Such a system of contour terracing has been practised in China from time immemorial.

But wherever torrential rains occur there is always a danger of gullies being started in the bare soil. Gullying can be initiated either by careless methods of soil management or, on grassland, by over-grazing which bares the surface. In the early stages such gullying can be checked by throwing dams across the gash, made of anything that will hold up the rush of water and cause the sediment to accumulate. Even more effective has been the introduction of rapidly growing vegetation—*e.g.*, Kudzu (*Pueraria thunbergiana hirsuta*), a creeping leguminous plant which not only checks the flow of water and filters out the silt, but binds the earth and at the same time gathers nitrogen.

The examples of erosion hitherto described are those that are due to unthinking exploitations of the soil by civilized man.

Consideration should also be given, however, to what is taking place in Africa under native systems of farming. In the first place, it must be realized that whereas European farming is essentially founded upon a rotation of crops, in which a recuperative leguminous crop finds a place and in which livestock play their part in converting into manure those parts of the crops, such as straw, which are not valuable for human food, together with grass and other rough fodder, the African tribes, on the other hand, are for the most part still in the more primitive stage of "shifting cultivation." Under this practice the cultivator clears a plot of land, perhaps burning off the timber, before putting in his food crops. After two or three years of continuous cultivation the soil begins to become exhausted, and when that takes place and weeds become intractable, the plot is abandoned and a new piece of land is taken up. The abandoned plot in course of time recovers sufficiently to be taken into cultivation again, but under this system a tribe requires several times as much land as is actually under cultivation at any one time.

Another point of great importance is that the Bantu tribes, which predominate in East Africa, attach the greatest value to cattle, which represent wealth and position, but serve little or no economic purpose. They are not eaten, except ceremonially; by many tribes they are not milked; they are not beasts of burden, and their dung is not used as manure. At the same time every native is anxious to increase the number he owns, for on that depends his position in the tribe.

Within the past century, since British rule has maintained peace, the human population has increased very markedly, and this increase has been accompanied by an even greater increase in the numbers of livestock. The animal population has far outstripped the means of sustenance and is destroying vegetation in uncultivated areas which ought to be recuperating in readiness to be brought into cultivation again. The Kenya Land Commission, reporting in 1923, stated that "Probably about the year 1920 the main stock areas of the native reserves had attained their optimum carrying capacity, and although fully stocked were not overstocked." Since that time the cattle population has roughly doubled itself. Through persistent over-grazing, the ground has been beaten hard into little paths, even where it has not been eaten bare, and thus large areas have been laid open to erosion from rain, especially on the hillsides. Under cultivation, the humus of the soil rapidly becomes exhausted; the climate produces recurrent periods of drought followed by rainfall of fierce intensity, with a result that soil erosion, widespread

and disastrous, occurs. Furthermore, the native population not only practises a destructive and wasteful form of agriculture, but, as already mentioned, keeps a vast uneconomic herd of cattle, including the devastating goat in large numbers. It is small wonder that famine is never far away from some of the tribes, and if this is to be avoided the native must either change his methods or limit his numbers. African soil was never rich, and soil erosion has been developing for years without attracting much notice, but has now reached the stage where the growth of the desert may speed up catastrophically.

It is only recently that the dangers of erosion in Africa have been realized. The problem and the means of attacking it have, however, occupied increasingly prominent places in various Government reports since 1929, and it is now evident from Sir Frank Stockdale's report on his tour through Africa this year that all the African colonies have become erosion conscious.

Much yet remains to be done before the arrears of years of misuse of the soil can be repaired, and before the native population can be educated to systems of farming which will maintain the fertility of the land. Drastic changes in native custom will need to be brought about, and in many cases expenditure will be called for which can hardly be found within the limited resources of a particular colony.

The regeneration of wasted lands must begin with closing them for a time to grazing, so as to allow the return of natural vegetation. A certain amount of minor engineering is needed to check run-offs and dongas by dams and plantations. At the same time, cultivators must be taught the virtues of contour ploughing and planting and of vegetation strips in cultivated land.

Such measures, however, do not touch the major causes of erosion—*i.e.*, overstocking. To combat this, legislation is necessary with a view to compelling a reduction in the number of cattle. This must be done by way of purchase, and since the animals discarded would at first be practically valueless for food, factories would be required to turn the carcasses into fertilizer, and, later, into successively better products as the quality of the cattle dealt with improved. A reduction in the number of cattle or sheep to one-half would not only relieve the pressure on the land, but would give the native owners some chance of improving the quality of their livestock, both by selection and better feeding; whereas at present numbers only are valued. Education should also be the means of inducing the natives to use cattle economically for milk or meat and

for traction, or at least to sell them for food. One cannot escape from the fact, however, that forcible limitation of the number of cattle a man may hold will be a grave interference not only with tribal custom, but also with the dignity of individuals. One idea which has its attractions is that a special token currency should be introduced for the purchase of native livestock that would constitute a visible display of wealth and status.

Even more fundamental must be the education of the natives in the adoption of a conservative system of farming—a rotation that would include leguminous crops, and thus help the native dietary as well as restore nitrogen to the soil. Already compost making is another means of maintaining fertility that is being taught to the natives. The African cannot increase or even maintain his present numbers unless he learns how to use his plot of land so that it will continuously produce food. Demonstrations have shown how it can be done, but it will need both a strengthening of the agricultural staff and years of effort before the improved practices are taken up. Effort in all these directions on a large scale is an urgent necessity. Many of the tribes are on the verge of starvation, the desert is growing apace, and as the cropping or grazing area shrinks the pressure upon it becomes greater and destruction proceeds at a compound interest rate. Responsibility for action must lie not only on the colonial Governments, but on the British Government itself, which has declared itself trustee for the native populations and must save them from themselves.

RECENT RESEARCH IN UGANDA ON BLACKARM DISEASE

BY

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THE present paper is intended to supplement the previous account* of this disease as it occurs in Uganda, and to bring the information up to date.

Since 1930 this disease has not been epidemic over large areas in Uganda, though in some seasons considerable damage has occurred in restricted areas, notably in Usuku, Kumi and Ngora counties of Teso District and Bukedea county of Bugwere District.

The mode of development of the disease on stems and branches of the cotton plant ("blackarm") from the leaf form ("angular leaf spot") has already been described, and all the more recent observations made at Kampala and Serere have confirmed this sequence. No relation between blackarm and the various insect pests of cotton has been found in Uganda, beyond the fact that the ragged edges of leaves suffering from *Lygus* attack are somewhat more susceptible to infection by *Bacterium malvacearum* than undamaged leaves, but this greater susceptibility is not reflected in any increase in stem infection, and for that reason can be ignored as having no influence upon crop production or upon the general health of the plant. Sometimes, it should be noted, damage caused by *Helopeltis* to the leaves of the cotton plant is wrongly diagnosed as being due to *B. malvacearum*, and vice versa.

In Uganda infection of the seed supplies is almost entirely limited to the exterior of the seed and can be controlled to a certain extent by efficient sterilization, either by delinting the seed with sulphuric acid or by the use of certain proprietary dusts. Even with the most efficient surface sterilization of the seed, however, a small proportion of the seed gives rise to infected plants; some of this infection probably originates from seed with internal infection in the cotyledons.

Since 1930 a number of elaborate field experiments have been

* EMPIRE COTTON GROWING REVIEW, Vol. IX., 1932, p. 21.

conducted at Serere to determine the effect of seed disinfectants upon the subsequent history of the disease in the crop and upon yield. The results can be summarized briefly by stating that although certain of the disinfectants used gave fair control of the disease under field conditions, this control was not reflected in an increase in yield. Unfortunately these experiments did not coincide with seasons of heavy epidemic infection, so that we are not in a position to say whether in such seasons disinfection of the seed would result in less loss of crop. In Uganda seasons of heavy general infection with great loss of crop are comparatively rare, but the disease is always present in varying degrees. Under these conditions regular disinfection of the whole seed supply (about one and a half million acres are planted annually) each season is uneconomic, even were the disinfection to result in considerable increase of crop in the not very frequent " bad seasons." Besides this there are other practical and political considerations which rule out this method of dealing with the disease.

The influence of meteorological conditions upon the development of the disease during each season has been investigated in Uganda since 1930, and the data so accumulated indicate that there are two " critical periods " during the growth of the crop when rapid spread of the disease results in economic damage to the crop. The first of these critical periods covers the time from germination to the stage when the plants are ten to twelve inches high; during this period the plants lay down their main framework, including the development of the basal monopodia. Serious stem infection occurring at this stage, and developing from the cotyledons or lower leaves through their petioles to the stem tissues, may result in a large proportion of the plants receiving a serious check to their growth, either through the main stem being broken or by suppression of one or more of the basal monopodial branches. It is only with the vegetative and " monopodial " types arising from Nyasaland Upland that suppression of these monopodia results in a serious loss of crop. With the more " sympodial " types in which the basal monopodia are not of importance, if in fact they ever develop—such as U.4.4.2 and its derivatives—the only result of early stem infection is the loss of a few of the lower sympodia.

The second critical period coincides with the elongation of the sympodia, and in the Eastern Province, where most of the investigations were conducted, this occurs during the second rainy period in the months of September and October. The extent of spread of blackarm disease at this time depends upon the character of these second

or " late " rains; if the weather is continuously cloudy and showery, serious spread of the disease may be expected and the sympodia are infected in succession as they are developed by the plant. The result of such infection is that the plant at a later stage shows a gap or waist in which most of the sympodia are represented by short dry twigs bearing no bolls or flower buds; the extent of this gap is proportional to the length of the period of activity of the disease. The insect *Lygus* may also be responsible for the production of a " no-sympodia waist." This insect is believed to damage the bud giving rise to the sympodium—in which case it is entirely suppressed—or to damage the growing point of the sympodium, when further development of that particular fruiting branch is stopped. If the period of the late rains is broken by intervals of a few days of hot dry weather, bacterial infection of the sympodia is not continuous and the damage is much reduced. Even at a late stage in these rains a few days of dry weather does much to limit the damage, as lesions formed during the wet and cloudy periods soon dry out and are then incapable of further extension in the tissues of the plant.

Analysis of the effect of soil conditions upon blackarm is difficult; the disease is more frequent and more serious in the areas of light soil. These areas also experience climatic conditions which are very favourable for the development of the disease, and it is therefore difficult to separate the effects of these two causes. Recent research by one of us (H. R. H.) has shown that the cotton crop in Teso is closely correlated with the amount of rainfall of the preceding " dry season " lasting from the end of December to the middle of March. Cotton is planted from May to the end of August (a little is planted late in April), so the effect of the " dry season " rainfall must be exercised through the medium of the soil. Low rainfall during the " dry " period results in desiccation and very probably causes the soil structure to deteriorate; these effects can only be partially neutralized or reversed during the heavy rains of April and May.

Varietal Resistance to Blackarm.

At an early stage in these investigations it became apparent that considerable varietal resistance—or tolerance—existed. In the 1929-30 season, for example, a single plant was found growing in a native plot in North Teso which was markedly resistant to blackarm disease. This plant gave rise to the series of strains known as Nariama derivatives—named from the place of origin—which still show high resistance after several years' reselection. Again

in 1930-31 U.4.4.2 direct from South Africa displayed more resistance to the disease than the standard cottons growing beside it. From the beginning (*i.e.*, in 1930-31) rigid selection against blackarm susceptibility has been adhered to at Serere. Any plant in a progeny row which displayed symptoms of the disease was discarded. Seven years of selection on this basis has resulted in strains which are at least ten times more resistant than the standard cottons N.17 and S.G.29.

From the start it was realized that absolute immunity did not exist, and it became necessary to evolve criteria for the *amount* of infection on individual plants, as it was found that large healthy plants could show signs of slight infection which had little or no effect on their yield, but these plants would be discarded under the system of rejecting all those showing even slight symptoms of the disease.

In 1932-33 a large number of S.G.29 plants were examined to determine the effect of various forms of the disease upon yield. The results are summarized below, the losses being estimated on the number of bolls produced under each type of infection compared with the boll production of healthy plants.

Form of Attack.	*Number of Plants.*	*Per Cent. of Crop Lost.*
Infection at the base of main stem	17	30
Infection on basal monopodia which was not severe enough to suppress this type of branch	10	nil
Infection on sympodia, causing considerable loss of these branches	765	28
Reduction of basal monopodia to one only; in most cases due to blackarm	128	40
Complete absence of monopodia due to blackarm in most cases	102	63

In this experiment it was found that the leaf form of the disease (angular leaf spot) had no effect on crop production, except in so far as it gave rise to infection of the stems or branches.

These results, together with later experience as it was accumulated, were applied to all varieties grown each year in the cotton breeding plots at Serere. The routine observations are recorded as follows:

For each strain taken as a whole: (i.) Percentage of plants showing angular leaf spot attack; (ii.) percentage of plants free from any form of blackarm disease.

For each individual plant in any strain: (*a*) Number of lesions on stems; (*b*) number of lesions on branches.

From (*a*) and (*b*) the mean number of lesions per plant for each strain can be determined.

Selection work on this basis was complicated by the discovery that high resistance was correlated in some cases with low yield and slow growth; in consequence all selections were made for high yield coupled with resistance. The results of this work were tested each year in replicated field trials, and are summarized below:

Group.	*Strain.*	*Date of Selection.*	*Average Number of Lesions per Plant.*		
			1934–35.	1935–36.	1936–37.
Nyasaland Upland ..	S.G.29	1924–25	4·6	6·1	1·9
Nariamas derived from Nyasaland Upland	S.P.72	1932–33	3·1	1·4	—
	S.P.88	1933–34	—	—	0·4
A hybrid between S.G.29 and an unknown cotton	S.P.89	1933–34	—	—	0·4
U.4.4.2 derivatives ..	S.P.1	1930–31	1·3	—	—
	S.P.20	1931–32	1·2	1·3	0·3
	S.P.48	1932–33	1·0	1·2	—
	S.P.84	1933–34	—	—	0·4
Least significant difference			0·3	0·3	0·1

Strain.	*Yields of Seed Cotton expressed as Percentage of S.G.29.*		
	1934–35.	1935–36.	1936–37.
S.G.29	100	100	100
S.P.72	109·4	134·4	—
S.P.88	—	—	122·0
S.P.89	—	—	121·5
S.P.1	164·1	—	—
S.P.20	178·6	156·9	139·6
S.P.48	205·6	160·8	—
S.P.84	—	—	128·3
Least significant differences	11·1	20·9	6·2

In 1934-35 these trials were combined with a test of the effect of seed disinfection by dusting: though the plots sown with disinfected seed showed less disease than the controls, no significant differences

in yield resulted. In view of the large differences observed in the resistance of the varieties used, an analysis of the data was made to determine whether the yields of sub-plots of each variety bore any relation to the amount of disease found in the plots. The results obtained showed that there was no correlation between disease and yield in any one variety after the effects of sowing date, site of plot, etc., had been eliminated. Such results were unexpected in view of field experience with the disease and of results obtained from individual plant records. The experiments under consideration were not conducted during a season of severe damage, as such a season has, fortunately, not recurred since 1929-30.

The results given above do not allow for the fact that large plants carry a higher number of lesions than small plants, and in the analysis of the results of 1935-36 and 1936-37 efforts were made to compensate for this by obtaining the mean number of lesions per pound of vegetable matter produced in each sub-plot: this figure was termed Blackarm Intensity.

The results are given below:

	Blackarm Intensity.	
	1935–36.	1936–37.
Varieties.		
S.G.29	17·00	4·88
S.P.72	3·42	—
S.P.88	—	0·80
S.P.89	—	0·87
S.P.20	4·17	0·69
S.P.84	—	0·89
Least significant difference	1·02	0·32
Sowing Dates.		
May	12·14	2·31
June	6·60	0·88
July	3·42	1·19
August	0·81	1·91
Least significant difference	1·74	0·70
Spacings.		
$3' \times \frac{1}{2}'$	8·05	2·50
$3' \times 1'$	5·25	1·27
$3' \times 1\frac{1}{2}'$	3·92	0·94
Least significant difference	1·08	0·22

The actual measures used for estimating infection on individual plants in the breeding plots have been elaborated gradually as

experience dictated and are now applied as routine observations each season. The whole of the present method may be summed up as an attempt to arrive at a single figure to indicate the amount of infection present upon each individual plant during the whole of its growth period, and efforts are still being made to improve the accuracy of this index. The work is now being extended to the investigation of the inheritance of resistance to blackarm in hybrid cottons bred at Serere.

The results obtained at Serere since 1930-31 show that in seasons of average blackarm intensity this disease can be controlled most easily by means of resistant varieties, and there is every reason to suppose that in the exceptional seasons when the disease becomes epidemic and serious over large areas, the benefit obtained from growing such varieties will be even greater.

Received November, 1937.

NEW SAKEL STRAINS IN THE ANGLO-EGYPTIAN SUDAN

BY

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[The following article was received by us shortly after we had accepted for publication the text of a more generalized article by Mr. Trought, which also dealt with cotton breeding in the Sudan (published in the July, 1937, issue). As the two papers overlapped to some extent, it was decided at that time not to include both. It now appears, however, that the account of the origin of the X1530 and X1730 strains had been, by intent, much condensed in the expectation that the further details necessary would be made available in the present paper. The two articles are therefore complementary, and in view of this and of the outstanding importance of these selected strains in the country of their origin it has now been decided to publish them both, with as short an intervening period as possible.—Ed.]

During the ten years 1923 to 1933 various cotton selections have been made by the author in the Sakel* crop grown under irrigation in the Gezira area. Three of the strains originating from these selections, the X1530, X1730, and Lecrem strains, which are now beyond the experimental stage, may be of some general interest to cotton breeders, the former both for its history and its intrinsic qualities, and the latter more particularly on account of its origin and the methods employed in its production.

Of the new Sakel type cottons at present in course of development, the two referred to in this article are those in the most advanced stages of large-scale production.

The selection work recorded here could only be carried out as opportunity allowed in the course of other duties, and the work was also handicapped by the lack of trained staff. In consequence the methods employed were necessarily of a rough-and-ready character, and they were also often unorthodox. As results of value have been obtained by such means, however, an account of this work and some conclusions based on the experience obtained may be of practical value to others.

* The colloquial term for Egyptian Sakellarides cotton has been used throughout this article.

X1530 *and* X1730 *Strains.*—These strains are bracketed together as having the same origin, and being, in fact, almost identical in character. In 1937-38 the X1530 strains have replaced the main-crop Sakel over nearly 95,000 acres in the Gezira and about 35,000 acres in the Tokar and Gash Deltas. In its vigorous growth, resistance to a major disease—leaf curl—and remarkable capacity for recovery after severe blackarm infection, it is markedly superior to the main-crop Sakel.

X1530 gives an increased yield of seed-cotton of 30 per cent. or more over the ordinary Sakel, and with about 2·2 per cent. higher ginning outturn, the higher production per acre much more than offsets the rather lower prices hitherto obtained. Although it is subject to the seasonal fluctuation in yield common to all cotton types in the Gezira, it has shown the very valuable quality that the depression in yield under adverse conditions seems to be less than is the case for the ordinary Sakel type. Consequently, by growing this type it should be possible to avoid the extreme fluctuations in yield per acre that have occurred in the past.

Compared with X1530, X1730A (a derivative of X1730) is a little more vigorous in growth, gives a rather higher yield, and the lint quality is probably slightly superior. This strain is now being rapidly propagated as a possible substitute for the X1530 strain.

The parent plant of both strains was selected by the author in 1923-24 season within a field crop of R. E. Massey's Sakel No. 186, a high-quality Sakel originating in an importation from Egypt in 1913. The records show that the original plant selected in 1923-24 season was of essentially the same character as that of the present X1530 and X1730 strains.

By 1927-28 season, after four years' selection work, seven families descended from the one parent plant were being grown. Some of these were of the same plant type as the original parent, and others (in an attempt to secure higher resistance to blackarm infection) showed some variations from this. These off-type families were discarded at a later stage.

Each of these families was picked as a separate bulked lot, which was taken over by the plant breeder. In the following season, 1928-29, two plants selected from the progeny of one of these families gave rise to the X1530 and X1730 strains respectively.

The rapid spread of leaf curl in 1928-29 season necessitated selection for resistance to this disease (the type itself being fortunately much more resistant than the main-crop Sakel), and in 1930-31 season, after re-selection for this character and for general qualities, the two

strains were bulked for propagation. (In later references to "type" characteristics "X1530" can be taken to include both X1530 and X1730 strains, owing to their very close similarity in these respects.)

This is, briefly, the early history of the type. Since it has also certain distinctive plant characters, some notes on these may be of interest; but before giving these, however, there are certain points in regard to the actual selection work and subsequent treatment to which attention may be drawn.

During the ten-year period when the selection work was being carried on, very large numbers of plants from all parts of the Gezira were examined by the author, and considerable numbers of selections were made. Up to 1929-30 season, by a process of rigorous elimination, all the selections made within this period had been scrapped except those originating from the X1530 ancestor. Plants of outstandingly desirable characters such as the X1530 type appear to have been of exceedingly rare occurrence, and no doubt this is also the case in other areas and among other varieties. The chances of finding and selecting plants of very desirable characters, therefore, are likely to be exceedingly remote unless a very wide net is cast, and unless the population examined is very large. This is the point first illustrated by the work. There is nothing new in this, but it is obviously of importance in cotton-breeding work.

Secondly, in respect to the selection work both in the field and among the progenies of the selections made, lack of time and staff imposed the necessity of reducing written records to the minimum, and as the results showed, the essential minimum was considerably less than what would otherwise have been done under more favourable conditions.

There is one other point. In the earlier years of the work on the X1530 type, when the spinners' demand was all for improved quality of lint, this strain was very nearly dropped completely owing to a lack of lint quality superior to that of the main-crop Sakel, and in spite of the other superior qualities of the strain. Nowadays, however, the emphasis in cotton-breeding work is much more on higher yielding qualities, with consequent reduction in cost of production and often of price.* Under these changed conditions the high yielding qualities of X1530 are more important than formerly. This change in demand does in fact illustrate very

* The difficulty so often found in this connection is that the quality of a strain of cotton is frequently lowered before long as the yield and ginning outturn are increased; emphasis on the two latter characteristics may therefore affect the saleability of the product.—ED.

well how important it is for the cotton breeder to have "on tap" a very large range of types (even to one producing poor-quality lint, but plenty of it) ready for any change that may occur in the market demand.

As noted previously, the general type has certain distinctive characteristics, and probably some of these are also contributing factors for its vigour and ability to give a satisfactory crop under adverse conditions. Internodes are short, and the main stem strong and upright. There is, therefore, very little "lodging." Fruiting starts at a higher node on the main stem than with the ordinary Sakel, and picking consequently begins later. The larger proportion of the crop borne on vegetative branches also has the same effect.

The tendency to delay in the beginning of picking probably assists the plant to make its rapid recovery after a blackarm attack. This is so because the disease, when it occurs, develops early in the season, and any early-formed fruits are liable to be shed or damaged with corresponding reduction of the final crop. With less fruit produced at this stage, therefore, X1530 suffers less loss than earlier fruiting types. X1530 is, indeed, not more resistant to infection than the ordinary Sakel type, but differs from it in its power of recovery afterwards.

Certain other characteristics may be noted. Compared with the ordinary Sakel type the leaves are rather broader, and somewhat "brighter" in appearance; the bolls are slightly more rounded, and have a slightly lower length/breadth ratio. Four-lock bolls are of frequent occurrence. The flowers are almost indistinguishable from ordinary Sakel, but with the petal colour possibly of a slightly deeper yellow.

The question as to whether this type originated as a mutant or by hybridization appears to be solely of academic interest, and cannot now be determined. In the first progeny obtained many off-type plants occurred which chance hybridization could probably account for, but there seems no doubt that the parent type itself had already been fixed at this stage.

Lecrem.—In the 1937-8 season an area amounting altogether to about 5,000 feddans of the Lecrem strain is being grown in the Gezira and in the Gash Delta propagation area.

Though of typical Sakel type this strain shows high resistance to leaf curl disease, and the original selection was, in fact, made mainly on this character. It has also given rather higher yields

than the main crop. The lint quality is probably very similar to that of the main crop, although in early spinning tests it was classed very highly.

The chief interest for the cotton breeder, however, lies in its history. In 1929-30 season various field selections for resistance to leaf curl were made in severely infected areas. In the following year these selections were tested in short progeny rows against heavily infected controls, and several of them were found to be highly resistant. In this year nearly the whole Gezira crop had become infected with leaf curl, and it was obviously of the greatest importance to obtain a resistant strain in bulk in the shortest time possible. With this end in view seed from two of the resistant families* of the general Sakel type was bulked as one lot, and in its propagation during the two following years extremely rigorous roguing was practised, not only for type and resistance to leaf curl, but also for the lint quality and high yield of each individual plant. Testing for disease resistance was assured by having a number of infected plants growing throughout the plot, these being sterilized by pulling off flower-buds to prevent crossing. In the next season, 1933-34, roguing was continued on a nucleus plot, but not so rigorously as in previous years. Over thirty feddans were sown in this year, and since then bulk propagation has been carried on.

The strain produced thus is, as has been noted, of a typical Sakel type, although it maintains a high resistance to leaf curl disease. The strain does, in fact, appear to be of a more homogeneous character than the main-crop Sakel, this result being no doubt due in part to the roguing process having probably eliminated more of the progeny of one of the parent families than of the other, although in any case the two families were nearly allied in character.

In this account of the formation of the strain the feature of most interest to cotton breeders will be the length of the period from selection to the bulk propagation stage. In 1933-34 season, three years after sowing the progeny rows, thirty-two feddans of the strain were sown for propagation, and this area could have been several times larger with intensive propagation methods, At this time, owing to the simultaneous development of X1530 (also resistant to leaf curl) and discovery of efficient control measures, Lecrem became of less importance; otherwise this strain could have provided a resistant type of satisfactory general characters within a comparatively short period.

* Both families were selected in R. E. Massey's "Domains Sakel," a high quality strain from seed imported from Egypt in 1922.

As the time factor is of the utmost importance in plant breeding, especially for disease resistance, any way of shortening the preliminary period is of importance. In the present case the amount of seed available at the beginning was doubled by using two parent plants instead of one as is usual; and reliance was placed on extremely rigorous roguing in place of selfing and re-selection.

The successful use of two families in originating the Lecrem strain suggests some interesting possibilities. Might not "strains" resulting from selected multiple parents often give more satisfactory results to the cotton grower than "pure" strains? Do we, indeed, attach too much importance to the use of pure strains for commercial cotton growing?

The rather revolutionary idea that such "mixed" strains may be of more value for commercial cropping than pure strains finds some support in practical work with animals and other plants, as well as with cotton. The advantages of a "mixed" compared with a pure strain may be due not only to the increased vigour resulting from the crossing between different types, but also to the wider range of genetical characters included within the strain. The latter feature is probably much more important, and it is no doubt due to this that impure strains may be more successful when grown under a wide range of conditions. This is illustrated by an American Upland strain in the Sudan known as "Pump Scheme Strain" (believed to have originated from Nyasaland Upland), which is very impure, being made up of many varied plant types. For many years it has constituted the main crop under the widely differing environmental conditions of the Northern Sudan under irrigation and the Southern Sudan under rainfall. It is now being replaced by two pure strains, one for each zone, but the greater adaptability of the Pump Scheme Strain made it difficult to beat when one strain only was used for both zones.

Harland has referred to the importance of a wide range of genetical inheritance among cottons from the point of view of selection and isolation of desirable characters;* the deliberate mixing of pure strains for growing commercially, however, does not appear to have received attention. The system of pooling seed of different strains sometimes practised is used only for selection among the progeny, and the mixture is not propagated in bulk. Eventually, probably, the idea might have useful application with the synthesized types produced by the geneticist. Meanwhile,

* "The Acclimatization of Cottons in New Areas," by S. C. Harland, EMPIRE COTTON GROWING REVIEW, 1932, Vol IX., p. 285.

however, experimental tests might discover a number of successful " mixtures " which could be made.

To return to our subject—the possible effects of " hybrid vigour " and wider genetical inheritance may be only slight in the Lecrem strain, but they should not be ignored on this account, for even slight differences become important when large areas and numbers are concerned.

The results outlined above illustrate the possibilities of selection work when carried out on a sufficiently extensive basis. The production by the geneticist of a new strain by hybridization is a long process, and there is necessarily some uncertainty as to the eventual outcome of the work. If, however, a plant with the genetical qualities desired can be selected " ready-made," an immediate step forward is possible. The increase in cash return to the grower from the introduction of any definitely superior strain is likely to be so great that extra expenditure in the search for such rare plants would appear to be very well worth while, as, indeed, is shown in the results of the work described here. In any case the possibilities of such selection work can only be determined if a sufficiently extensive survey is made.

MANURIAL REQUIREMENTS OF COTTON VARIETIES

BY

FRANK CROWTHER, D.Sc.

The cotton-plant breeder selects a new variety either for its greater yield or for the superior quality of its lint, and it is usually on these merits alone that the variety is adopted for commercial cultivation. Nowadays growers are so eager to test the possibilities of a new variety that the breeder is compelled to release it at the fledgling stage, as it were, before he has examined the conditions of diet and environment under which it thrives best. In the absence of special recommendations the grower begins by treating the new variety as he did its predecessors, and only gradually modifies his practice in accordance with experience. Meanwhile, not only is he missing some of the extra profits from growing the new variety, but also the life of a variety may be so short that, no sooner has he fully grasped its requirements, than he has to repeat the operation with another variety. Such a procedure is very wasteful.

That it may amply repay agricultural departments and landowners to include a range of manurial treatments in their comparisons of the newly released variety with the older ones, is illustrated by some results of recent experiments carried out in the Nile Delta by the Royal Agricultural Society, Imperial Chemical Industries, Limited, and I.G.Farbenindustrie Aktiengesellschaft Joint Agricultural Research Scheme. These results show large differences in manurial response among the varieties Ashmouni, Sakellarides (older varieties), and Maarad, Giza 7 and Giza 12 (newer varieties).

The detailed results of the experiments have been published in bulletins of the Royal Agricultural Society, Cairo (Nos. 22, 24, 25, 26, 30, 31, and 32), and the reader is referred to them for descriptions of layouts and factors compared. The experiments were made in three seasons, 1934-36, and most experiments consisted of 216 plots, covering an area of 8 to 10 acres. The sites were scattered throughout the Delta and were representative of large areas of land.

In Egypt the initial supply of organic manure is inadequate;

moreover, a large quantity is used for fuel, and the bulk of the remainder is usually applied to the maize crop in the rotation. The farmer must therefore rely on inorganic fertilizers if he wishes to augment the supplies of available soil nutrients for cotton as well as for other crops. At the time of the initiation of the Joint Scheme, however, manures were not generally applied to cotton in the Delta, for there was confusion of opinion about their effects. In the experiments nitrogen was applied as a mixture of nitrochalk and German nitrate of lime, and phosphate as superphosphate.

Nitrogenous Manuring.—A comparison of the yield increases of several varieties with different rates of nitrogenous manuring (VN) is given in Fig. 1. All other varieties are compared with Maarad, because Maarad was the only variety common to all experiments. The values are averaged from two to eight experiments. The rates 0N, 1N, 2N, 3N denote rates of nitrogenous fertilizer increasing by 100 kilograms* from no-manure to 300 kgs., and these rates correspond roughly to 0, 2, 4, and 6 cwts. fertilizer (15·5 per cent. N) per acre. The yields are expressed as percentages of the no-nitrogen yield of each variety.

The varieties showed pronounced differences, Giza 12, Giza 7, and Ashmouni showing larger increases than Maarad, and Sakellarides smaller. The differences between the varieties widened as the rate of manuring increased, so that with the heaviest rate the increase of Giza 7 was almost *double* that of Maarad, which in turn was *double* that of Sakellarides. This individuality in the behaviour of all varieties to manuring shows clearly that the farmer's manurial programme must be related specifically to the variety grown, for a rate which is profitable with one variety may prove unprofitable with another. Thus, for the mean of all experiments, and with prices of cotton and fertilizer averaged from those obtaining in 1935 and 1936, manuring with 2 cwts. was profitable with all varieties; the further profit from 4 cwts. was considerable with all varieties except Sakellarides; the heaviest dressing caused a loss with Sakellarides but a still further profit with Giza 12.

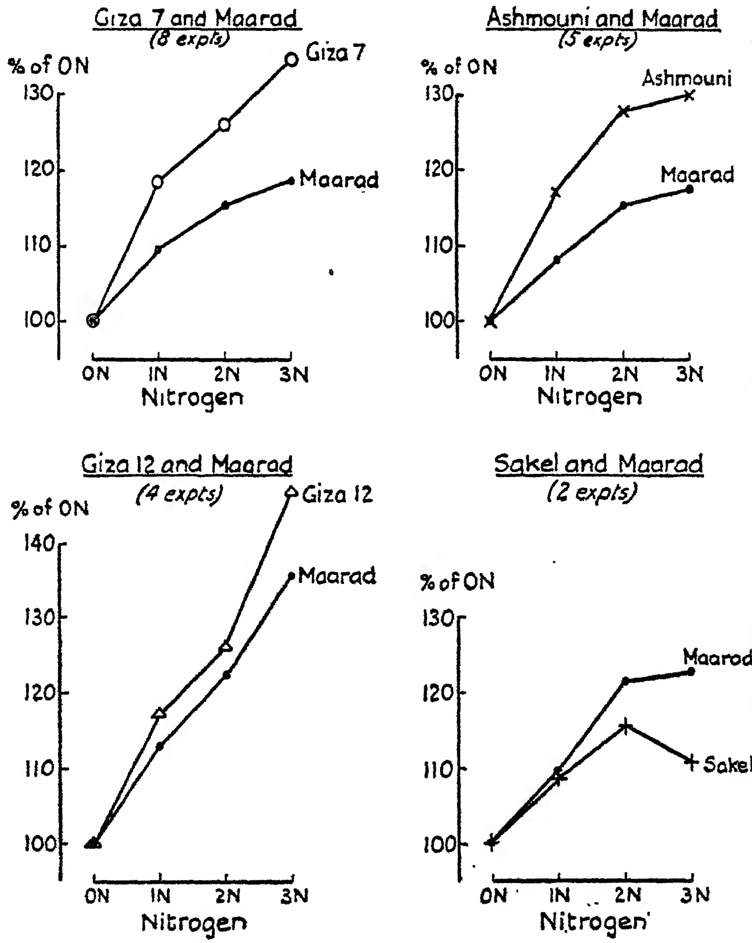
The importance for Egypt of these varietal differences is stressed when the areas of the varieties are considered in proportion to the total area of the crop each year. From 1916 to 1927 Sakellarides formed more than half of the total Egyptian crop; since then Ashmouni has been the most widely grown variety, and in 1936 comprised 58 per cent. of the total crop, as compared

* 100 kilograms per feddan=228·8 lbs. or 2·04 cwts. per acre.

FIG. 1.

YIELD RESPONSE OF VARIETIES TO NITROGEN

(Percentage of ON plots)



with 9 per cent. for Sakellarides. Thus, from the point of view of nitrogenous manuring the *least* responsive of all those compared in the experiments has given place to one of the *most* responsive. At present the rest of the crop is mainly Giza 7, and this, too, gives large profits with nitrogenous manuring. Giza 12 has only been on the market for one or two seasons, and its area has not yet become appreciable, but its behaviour is in line with the trend of the last twenty years—from varieties which give little profit from nitrogenous manuring to those which may give handsome profits with dressings of even 6 cwts.

The significance of this change in variety is that nitrogen supply is no longer merely a minor factor controlling cotton production, but has become one of outstanding importance, and the profits which the grower makes on his cotton depend nowadays upon his recognition of the optimum rate of manuring, as determined by the nitrogen status of his soil and the variety which he grows.

Phosphatic Manuring.—The response of the Egyptian cotton to added phosphate, whatever the variety, is small in comparison with its response to nitrogen. Whereas in individual experiments the mean increase of all varieties with nitrogenous manuring ranged up to 64 per cent., the corresponding increase with phosphatic manuring in any experiment never exceeded 5 per cent. Thus, varietal differences with phosphatic manuring are necessarily much smaller than those with nitrogenous manuring. Varietal differences with phosphate (VP) were significant in the *yield* results of one of the two seasons only, but, as will be shown later, similar differences in *crop development* occurred in both seasons. Fig. 2*a* gives the yields of four experiments involving variety-phosphate comparisons, the application of superphosphate (16 per cent. P_2O_5) being 1P (approximately 2 cwts.) in 1935 and 2P (approximately 4 cwts.) in 1936. The differences reached statistical significance at two centres, Qorashia and Sakha. Considering the results as a whole, Maarad and Giza 12 reaped greater benefit from superphosphate than, for instance, Giza 7. This relative order for Maarad and Giza 7 is the reverse of their order for nitrogenous manuring. At Qorashia, for example, with nitrogen the yield increase of Maarad was significantly *inferior* to that of Giza 7 and with phosphate significantly *superior*.

Varietal Differences in Crop Development with Manuring.—The nature of the varietal differences becomes evident when the data from crop development are analyzed. Table I. gives the results of statistical analyses of the data for size and numbers of bolls

for the variety-nitrogen and variety-phosphate interactions, and comparable results for yield are also included.

TABLE I.—STATISTICAL ANALYSES OF VARIETAL RESPONSES TO MANURING.

Experiment.	(*a*) *Size of Fruit.*		(*b*) *Nos. of Fruit.*		(c) *Yield.*	
	VN.	*VP.*	*VN.*	*VP.*	*VN.*	*VP.*
1935.						
Abu Hammad ..	O	O	O	O	SS	O
Qorashia	O	S	S	O	SS	SS
Sakha	O	O	O	O	SS	S
1936.						
Mahallet Roh ..	O	S*	O	O	SS	O
Ibrahimia	O	S	S	O	O	O
Shaba	O	S	S	O	SS	O

SS indicates that the interaction was highly significant ("Z" test: P < ·01); and S that it was significant ("Z" test: P < ·05).
* Significant only where the crop was sown at wide spacing.

Considering the data for *size* of boll (weight of seed-cotton per boll), in all six experiments involving variety-phosphate, the Maarad boll was enlarged more by phosphatic manuring than the bolls of the other varieties (Fig. 2*b*). The increase in Maarad's boll size with phosphatic manuring varied from 2 to 5 per cent. according to the experiment, and in four out of six experiments the differences reached significance [see Table I. (*a*)]. In yield the varietal differences in response to phosphate were significant only in two of the 1935 experiments. With nitrogenous manuring, on the other hand, although there were very pronounced varietal differences in the final yield there were none in the data for size of boll.

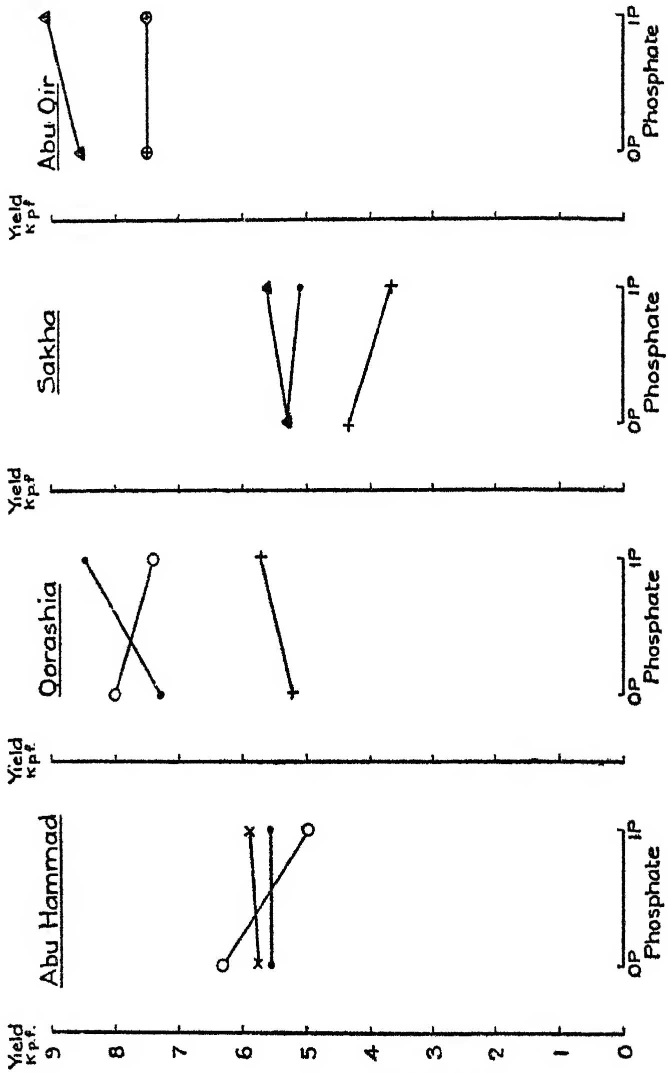
In the data for *number* of bolls the situation was reversed, and phosphatic manuring showed no significant varietal differences, whereas nitrogenous gave significant differences in three experiments, and in the other experiments the results, though failing to reach significance, showed the same trend.

Thus there is a clear distinction between the effects of nitrogenous and phosphatic manuring on cotton varieties, nitrogenous manuring operating through differences in numbers of bolls and phosphatic manuring through differences in size of boll.

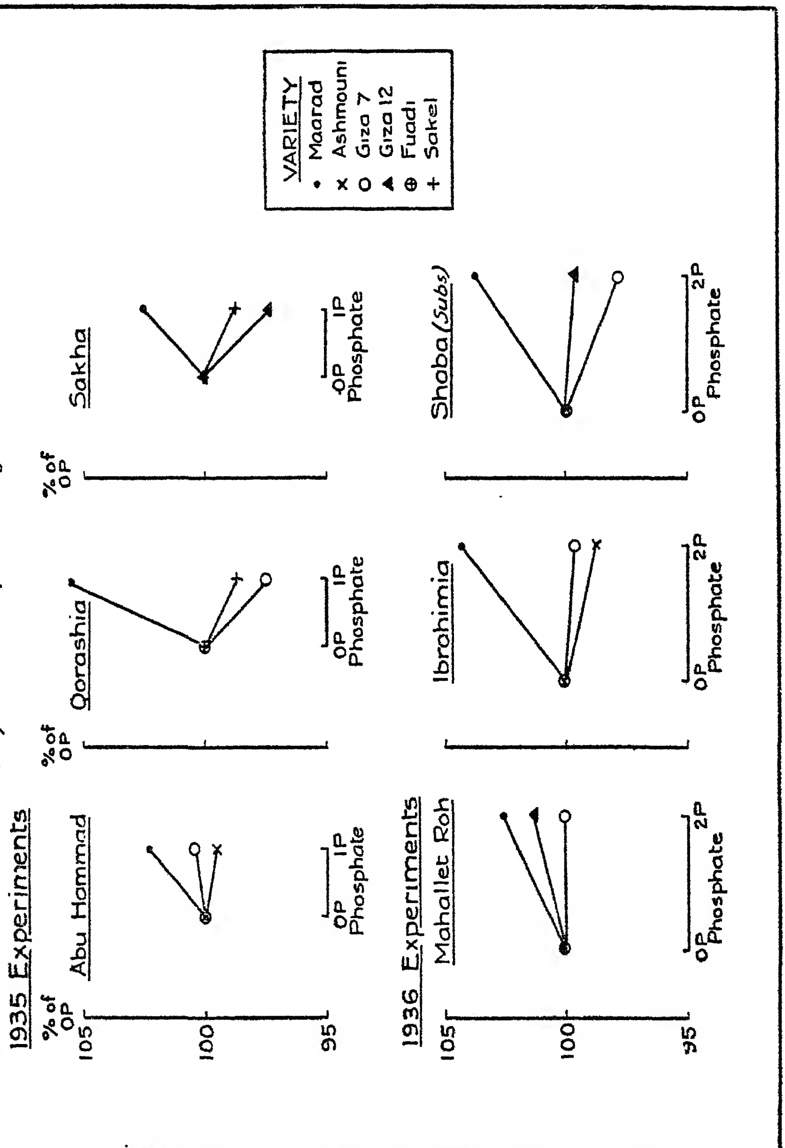
These characteristic functions of nitrogen and phosphate in the development of the bolls explain why the order of the varieties in response to the two types of manure is different. There is thus

FIG 2.

(a) YIELD RESPONSE OF VARIETIES TO PHOSPHATE APPLICATION (1935)



(b) WEIGHT OF SEED COTTON PER BOLL WITH VARIETIES AND PHOSPHATE
(Expressed as percentage of OP)



no increased responsiveness of the newer varieties to phosphatic manuring comparable to that for nitrogenous manuring, and any increase in the phosphate requirement of the cotton crop in recent years cannot be explained directly by changes in the popularity of the varieties. Examination of the spacing factor, which also was included in this series of experiments, shows the yield increase from phosphatic manuring to be greatest at close spacing. Hence the need for phosphate may have arisen in part from the exhaustion of soil supplies resultant upon the trend towards closer spacing during the last twenty years. But another factor has probably contributed, for the experiments showed a greater response to phosphate in the presence of nitrogenous manuring. Thus, although the newer varieties are inherently no more responsive to phosphate than those popular in the past, yet change in variety may have helped indirectly to create a need for phosphatic fertilizers, by encouraging the use of heavier dressings of nitrogenous manures.

The reader unfamiliar with the appearance of the Egyptian cotton crop may imagine that the large varietal differences in response to nitrogen revealed in the foregoing results arose from differences between varieties in vegetative growth, the more responsive varieties being the more vigorous growers. The varieties are, however, surprisingly similar in their vegetative habits, and there were few differences between them in the amount of increase of either leaf or total dry matter with nitrogenous manuring. In the isolated cases where the variety-nitrogen interaction in dry matter proved significant, the differences were not consistent from site to site. Hence the critical measure of responsiveness is not total increase in crop dry matter, but the extra yield produced per unit of dry matter (*cf.* grain-to-straw ratio in cereal crops). Often a cotton crop, impressive vegetatively in the field, in the end yields less abundantly than one which has appeared relatively stunted throughout the season.

At first sight it seems surprising that the critical measure of varietal response to nitrogenous manuring should be number of bolls produced, when all varieties flower abundantly and produce many fruits in excess of those which they bring to maturity. Undoubtedly in Egypt it is the *position* on the main stem of the extra bolls from manuring which is all-important. The greatest success lies with the variety which starts effective flowering earliest and maintains it at the highest rate. Compared with Sakellarides, all varieties examined in these experiments are characterized by their earliness. The position of the extra bolls from manuring is

always fairly high up the stem, but where flowering begins early and proceeds rapidly many extra bolls have still time to mature and be harvested before the onset of damage from pink bollworm.

This pest, which in the last twenty years has seriously curtailed the growing season, may alone seem an adequate explanation of the varietal differences in response to nitrogen, the earliest-maturing varieties being the most responsive. But in these experiments the same order of responsiveness of the varieties persisted, even in experiments where bollworm damage was light and in a season like 1936 when weather conditions led to early maturation of the whole cotton crop. It may be that the position of the extra bolls from manuring is determined by the rate of migration of plant nitrogen from the leaves to the fruits, which in turn may be regulated by the root system of the plant, for an early-flowering variety is presumably a "shallow-rooter," tapping a smaller volume of soil than a variety which matures later. But these avenues have yet to be explored.

The foregoing description of the varieties has concerned only those soils whose available food supplies have been deliberately raised by manuring. The existence of interactions between variety and manuring, both nitrogenous and phosphatic, suggests that similar varietal differences will arise on soils which differ naturally in supplies of soluble nutrients. Thus, in experiments laid down for the purpose of variety selection, it may well happen that the varieties will emerge in one order of yield on land of high fertility, in a different order on land deficient in available nitrogen, and in a third order on land deficient in phosphate. A plea is therefore addressed to plant breeders that they not only lay down their variety trials on sites representative of the different soil types, but also adopt generally the practice of including manurial factors, not merely in the final commercial tests but even in the early stages of selection. A combined-factor experiment need not involve a great increase in the number of plots, for the usual number of repetitions of each variety can be distributed over the manurial comparisons, providing both a straight comparison of the yields of the varieties and also a comparison of the behaviour of the individual varieties with the different types or rates of manuring.

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POTASH STARVATION AND THE COTTON PLANT—II

BY

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IN a former article under the same title (EMPIRE COTTON GROWING REVIEW, 1934, XI., 25) a description was given of a cotton crop suffering from potash starvation. This was grown in 1932-33 on the plots of a Permanent Manurial Experiment laid out on the farm of the Imperial College of Tropical Agriculture. Cotton was again grown on these plots in 1936-37, and the symptoms shown by the plots not receiving potash are remarkably similar to those described before, though, as might be expected, they are in some ways accentuated.

These plots are laid out on the ordinary five-plot system, one plot receiving a complete manure, while the others each lack one of the three ingredients—nitrogen, phosphoric acid and potash; the fifth plot is deprived of them all—*i.e.*, it receives no manure. There are three series of such plots: one as above; one similar, except that it received at the start of the experiment a dressing of ground limestone sufficient to satisfy the lime requirements of the soil; while the third receives a dressing of compost in addition to the mineral manures.

This cotton crop was the seventeenth crop to be grown under the same manurial treatment. The yields are given in Table I., and become more easy of interpretation when summarized as Table II.

The figures show that with proper manurial treatment the crop yielded well, though not quite as heavily as the one which was recorded on the previous occasion. They show, equally clearly, the effect of potash starvation, and it is evident that for cotton production on plots potash has become the limiting factor. On the plots where this element was not given, the cotton plants showed all the symptoms generally associated with potash starvation, the leaves being curled and marked with reddish-brown blotches.

In order to see whether the manurial treatments were having any effect on the ripening of the cotton, the crop was taken off in six pickings between March 11 and April 22, at intervals of eight,

TABLE I.—PERMANENT MANURIAL EXPERIMENT.

(Plots 1/20 Acre—all Figures per Acre.)

Crop No. 17 : Gossypium hirsutum (Acala Cotton).

Series.	*Plot No.*	*Manurial Treatment.*	*Crop No. 5, 1932-33.*		*Crop No. 17, 1936-37.*	
			Yield Seed Cotton (Lbs.)	*Percentage of Control.*	*Yield Seed Cotton (Lbs.)*	*Percentage of Control.*
I.	4	Nil	320	*100*	335	*100*
	5	N+P (lacking K)	500	156	350	104
	6	N+K (lacking P)	1,020	318	1,045	311
	7	P+K (lacking N)	940	294	880	262
	8	N+P+K (complete)	1,220	381	1,190	355
II.	12	Ca	460	*100*	560	*100*
	13	Ca+N+P (lacking K)	260	56	590	105
	14	Ca+N+K (lacking P)	1,020	222	1,135	203
	15	Ca+P+K (lacking N)	980	213	1,185	211
	16	Ca+N+P+K (complete)	980	213	1,345	240
III.	11	Com.+Ca	1,740	*100*	1,640	*100*
	9	Com.+Ca+N+P	1,460	84	1,260	77
	1	Com.+Ca+N+K	1,600	92	1,420	88
	10	Com.+Ca+P+K	2,020	116	1,675	102
	2	Com.+Ca+N+P+K	2,040	117	1,730	105
	3	Com.	1,940		1,475	

N=1 cwt. of sulphate of ammonia to each crop.
P=2 cwt. of superphosphate of lime to each crop.
K=½ cwt. of sulphate of potash to each crop.
Ca=10 tons at beginning of experiment (January, 1930).
Com.=10 tons compost or synthetic farmyard manure to each crop.

TABLE II.

Plots.	*Treatment.*	*Crop No. 5.*		*Crop No. 17.*	
		Yield.	*Per Cent.*	*Yield.*	*Per Cent.*
4, 12	Nil	390	*100*	450	*100*
5, 13	P+N (lacking K)	380	97	470	104
6, 14	N+K (lacking P)	1,020	260	1,090	242
7, 15	P+K (lacking N)	960	246	1.030	229
8, 16	N+P+K (complete)	1,100	284	1,270	282
4, 5, 6, 7, 8	No lime	800	*100*	760	*100*
12, 16, 15, 14, 13	Lime	740	92	963	126
1, 2, 9, 10, 11	Compost and lime	1,772	221	1,545	204

TABLE III.—THE BRITISH COTTON INDUSTRY RESEARCH ASSOCIATION.

TESTS ON FIVE SAMPLES OF SEED COTTON FROM THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD.

Sample.	*Mean Length 1/32 Inch.*	*Mode 1/32 Inch.*	*Effective Length 1/32 Inch.*	*Dispersion %.*	*Short Fibre %.*	*Hair-weight.*		*Immaturity.*		*Defective Seeds per 100.*	*Seed Weight (Gram).*	*Lint Weight (Gram).*	*Lint %.*
						Mean.	*Sorted.*	*% Normal.*	*% Dead.*				
Plot No. 2	33	38	41	17	15	177	137, 173, 174, 191, 211	40	11	13	0·109	0·070	39·1
N. P. K. and organic ..	35	40	40	13	10	183	189, 163, 171, 185, 204	36	23	14	0·104	0·065	38·5
	33	40	43	16	20	171	138, 144, 185, 202, 188	33	20				
Mean	34	39	41	15	15	177	155, 160, 177, 193, 201	36	18	14	0·107	0·068	38·8
Plots 5 and 13 ..	32	38	41	20	19	162	132, 144, 175, 187, 172	34	20	12	0·097	0·058	37·4
N. P. and N. P. Ca ..	35	40	41	15	12	167	156, 153, 173, 184, 170	39	19	13	0·100	0·060	37·5
	29	36	40	23	30	160	136, 163, 182, 183, 135	27	28				
Mean	32	38	41	19	20	163	141, 153, 177, 185, 159	33	22	13	0·099	0·059	37·5
Plots 6 and 14 ..	33	40	41	15	17	157	135, 141, 159, 174, 177	39	21	14	0·101	0·066	39·5
N. K. and N. K. Ca ..	34	40	41	15	12	167	153, 159, 165, 184, 174	27	21	11	0·100	0·064	39·0
	32	40	41	22	21	153	145, 140, 164, 174, 141	35	27				
Mean	33	40	41	17	17	159	144, 147, 163, 177, 164	34	23	13	0·101	0·065	39·3
Plots 7 and 15 ..	33	38	40	18	16	190	160, 177, 190, 204, 218	55	5	10	0·110	0·071	39·2
P. K. and P. K. Ca ..	37	40	41	12	5	177	134, 164, 191, 201, 193	41	20	8	0·110	0·072	39·5
	36	40	41	15	8	176	135, 172, 179, 180, 210	34	25				
Mean	35	39	41	15	10	181	143, 171, 187, 195, 207	43	17	9	0·110	0·072	39·4
Plots 8 and 16 ..	31	36	40	23	16	167	143, 159, 181, 171, 184	56	13	24	0·095	0·061	39·1
N. P. K. and N. P. K. Ca	34	40	40	17	12	156	133, 158, 163, 165, 160	34	26	7	0·117	0·072	38·1
	31	40	40	18	25	156	139, 146, 176, 172, 151	36	30	11	0·104	0·068	39·5
Mean	32	39	40	19	18	160	138, 154, 173, 169, 165	42	23	14	0·105	0·067	38·9

five, seven and nine days respectively. No differences are observable in the rate of ripening of the different plots, but the potash-deficient crops began to slacken off before the others.

Opportunity was again taken to estimate the effect of potash starvation on the development of the cotton fibre, and samples were sent to the Empire Cotton Growing Corporation, who kindly arranged for their examination at the Shirley Institute. The results of the tests are given in Table III., which may be compared with Table III. in the previous communication.

A careful consideration of this table shows few differences. It is, in fact, a matter of surprise that plots, which from lack of nutrition show such a great reduction in yield, should not show appreciable differences in the quality of the product. The mean hair-weight figures are significantly higher for the plot receiving organic manure (No. 2) and the plots receiving potash and phosphoric acid but no nitrogen (Nos. 7 and 15), but otherwise are remarkably similar. The same can be said of the other determinations, except that there are indications that the seeds from the no-potash plots (Nos. 5 and 13) are lighter, and their ginning percentage appears to be lower.

Further investigation into the quality of the seed was made, by testing its germination capacity. The results are shown below:

TABLE IV.

Plot Nos.	*Treatment.*	*Germination per Cent.*		
		First.	*Second.*	*Mean.*
2	N. P. K. (organic)	89	89	89
5, 13	N. P. (lacking K)	83	81	82
6, 14	N. K. (lacking P)	90	86	88
7, 15	K. P. (lacking N)	94	92	93
8, 17	N. P. K. (complete)	92	90	91

Tests of 100 seeds each: in damp sand. Tests were completed five days after sowing.

A difference of 5·6 per cent. is significant at the 1 per cent. point.

It is definite that, as far as germination capacity is concerned, malnutrition has in this experiment weakened the seeds and reduced their vitality, for the figure obtained for the seed from the plots which were short of potash is significantly lower than that from any others.

Summary.

The yield of cotton from plots suffering from marked potash starvation was, as on a previous occasion, very much lower than that from plots which had received potash, while the plants themselves showed all the signs of potash starvation. In spite of this, examination of the lint showed no marked differences between the plots, as might have been expected and as were indicated before. The seeds from the potash-starved plots were rather smaller in size and gave lower germination figures.

Acknowledgment.

I take this opportunity of expressing my sincere thanks to the Director and Staff of the British Cotton Industry Research Association for their kindness in carrying out the tests recorded in Table III.

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THE EFFECT OF VISIBLE, ULTRA-VIOLET AND INFRA-RED RADIATIONS UPON THE GERMINATION AND THE THERAPEUTIC TREATMENT OF COTTON SEED

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Of the many problems that confront the cotton grower that of obtaining successful germination is most important. Irregularity in the weather, *e.g.* in the rainfall, coming at any time during the germination period may cause the seed to rot and necessitate resowing.

To stimulate germination, and also to secure resistance to attacks of pests and diseases, pretreatment of the seed is recommended. The Department of Agriculture in India has widely advocated " sun-treatment " of cotton seed prior to sowing. Blackman[1] and Nye[4] recommended the use of H_2SO_4 treatment for surface sterilization of the seed, and also to obtain earlier and more regular germination. For some time past work has been in progress at this Experiment Station to ascertain the utility of irradiation methods in inducing more successful crop-production. The responsiveness of a number of crop plants, especially tobacco, has already been described by the authors.[5,6] In the case of cotton, subjecting the plants to ultra-violet rays for a series of intermittent exposures was so injurious as greatly to inhibit development (Fig. 1), but it was thought that short very occasional exposures might perhaps prove advantageous in this case as well as in some other plants.[6]

From economic and other points of view treatment of the seed was considered more important and more practicable than that of the plants, and the present work was undertaken to test the influence of varying dosages of the visible, the ultra-violet, and the infra-red rays upon the germination and the therapeutics of cotton seeds.

Healthy, pure strains of Late Verum cotton (*Gossypium neglectum*) were selected, and graded for uniformity as far as practicable. Standard seed germinators were employed, and observations were confined at first to small scale experiments in the laboratory under

known conditions of factor intensity, so that any conditioning that was variable, other than the treatment, might not dominate in any one or more sets and mask the results obtained. For confirmation of results the experiments were later repeated as pot culture.

Sun-treatment.—On the first day only seven seeds germinated in the irradiated set against ten in the control, and that loss was not made up until the end, as denoted by an identical difference in the percentage capacity of the two (Tables I. and II.). Evidently, therefore, sun heat has a tendency to retard germination, although ten hours' exposure did not seem significantly to cross the limits of tolerance.

Treatment with Ultra-violet rays.—A quartz-enclosed unscreened mercury vapour lamp, operated on 143 watts (130 volts, 1·1 amperes), was used as a source of radiation. The seeds were spread for treatment in an insulated basin in single layers at a distance of 60 cms. below the Hg arc to receive as far as possible a homogeneous radiation. In view of the previous experiments on tobacco[6] the range of exposure was kept between five and thirty minutes. The seeds were shaken a number of times during treatment so as to be operated upon on all sides.

The seeds responded well to this type of irradiation. Germination started earlier even in those which received five minutes' exposure (Tables I. and II.). A progressive decrease in the number of days to complete germination followed an increase in the period of exposure, so that seeds treated for half an hour finished germination within five days against eleven in the control. Even with seeds irradiated only for five or fifteen minutes the total percentage of germination in both cases considerably surpassed the control. The germination after such doses had a good start and consistently maintained a much higher level than the normal.

Longer exposures of thirty minutes' duration, on the other hand, inhibited germination, which was not prolonged for more than five days, owing to the forcing action of the rays. The total percentage of germination decreased to only thirty-two as compared with fifty in the control (Table II.).

Treatment with Infra-red rays.—The "Modified Sollux Lamp"* was used, wherein the radiation was generated by a high-power (1000-watt) tungsten filament source, operated at a temperature of about 2800° K. The uniform intensity of radiation was secured through a highly polished bowl-shaped reflector with scientifically

* For details refer to the "Hanoviya Equipment for Light Therapy," the British Hanoviya Quartz Lamp Co., Ltd., Slough, England.

calculated curvature. The method of arrangement of the seed for irradiation was the same as that used for the ultra-violet test.

The marked feature of this treatment was that when irradiated for five minutes partial scorching of the seeds occurred; when irradiated for half an hour they turned nearly black and appeared almost delinted.

The five-minute infra-red treated seeds, like the control, ger-

TABLE I.

AVERAGE* GERMINATION COUNTS IN *Gossypium neglectum* (VAR. LATE VERUM) RESULTING FROM SEED IRRADIATION OF A LOT OF 100 SEEDS PER SET.

Day after Sowing.	*Control (No Treatment).*	*Sun-Treatment, 10 hrs.*	*U.V. Treatment.*			*I.R. Treatment.*			*U.V.+I.R. Treatment.*		
			5 *mins.*	15 *mins.*	30 *mins.*	5 *mins.*	15 *mins.*	30 *mins.*	5 *mins.*	15 *mins.*	30 *mins.*
5th	—	—	12	14	6	—	—	—	—	—	—
6th	10	7	14	16	16	6	—	—	10	—	—
7th	4	7	10	12	2	6	—	—	4	—	—
8th	6	5	18	26	6	2	—	—	14	—	—
9th	8	5	8	6	2	4	—	—	8	2	—
10th	4	6	2	4	—	—	—	—	2	—	—
11th	2	4	2	—	—	—	—	—	2	—	—
12th	2	2	—	—	—	2	—	—	4	2	—
13th	6	3	—	—	—	—	—	—	—	—	—
14th	2	2	—	—	—	—	—	—	—	—	—
15th	2	4	—	—	—	—	—	—	—	—	—
16th	4	2	—	—	—	—	—	—	—	2	—

TABLE II.

RELATIVE EFFECTS OF SEED-IRRADIATION IN COTTON.

Treatment.	*Germination.*		
	Speed (Days).	*Duration (Days).*	*Capacity (Days).*
Control (no treatment)	6	11	50
Sun-treatment, 10 hours	6	11	47
Ultra-violet:			
(1) 5 minutes	5	7	66
(2) 15 minutes	5	6	78
(3) 30 minutes	5	5	32
Infra-red:			
(1) 5 minutes	6	7	20
(2) 15 minutes	—	—	—
(3) 30 minutes	—	—	—
Ultra-violet and Infra-red:			
(1) 5 minutes	6	7	44
(2) 15 minutes	9	8	6
(3) 30 minutes	—	—	—

* The experiments were repeated in triplicate and only the average tabulated.

minated six days after sowing (Tables I. and II.); no germination, however, occurred in any of the other seeds receiving longer exposures of fifteen to thirty minutes' duration. The general results of these experiments indicated that the effects of infra-red treatment were injurious to the seed.

Mixed Treatment.—The addition of luminous heat to ultra-violet radiation has been felt advantageous in light therapy; each is considered in some sense complementary to the other. A third type of treatment was arranged in which the two sources (ultra-violet and infra-red) generated radiation together.

The speed of germination of the five-minute irradiated seeds was normal; of the fifteen-minute treated it was delayed by three days, while with half an hour no germination occurred (Table II.). The seeds treated for five minutes completed germination in a week's time, like those exposed individually to ultra-violet or infra-red rays for a similar duration. Germination under this set approached very nearly the normal (untreated) in so far as the rate and the total percentage were concerned.

The five-minute ultra-violet treated seeds exhibited a significantly superior germination (66 per cent.), while those treated with infra-red for the same duration showed a very low percentage, viz. 20 per cent.; it was expected, therefore, that a mixture of the two radiations might induce an intermediate rate of germination, as actually happened in case of short exposures (Table II.). Beyond five minutes, however, the infra-red rays had a strongly dominating influence.

In the hope of obtaining better results, experiments were later on tried wherein the infra-red radiation was cut off from the combination after an exposure of two and a half minutes, the ultra-violet dose being continued for full five minutes. Such an adjustment resulted in about 14 per cent. increase over the normal. In another set of experiments an additional alteration was made—viz., the distance of exposure to the infra-red was increased from 2 feet to 4 feet. The germination in this case increased by 20 per cent. over the normal. This indicated the possibility of the useful utilization of the mixed treatment if properly adjusted by varying the duration of exposure and the distance of the material from the source of radiation.

Experiments on the Fungicidal and Germicidal action of Ultra-violet and Infra-red Radiations.—The enquiry was further extended to test whether or not irradiation could be used in reducing the incidence of plant diseases, especially when spread from the seed. For this purpose a number of cotton seeds artificially inoculated with

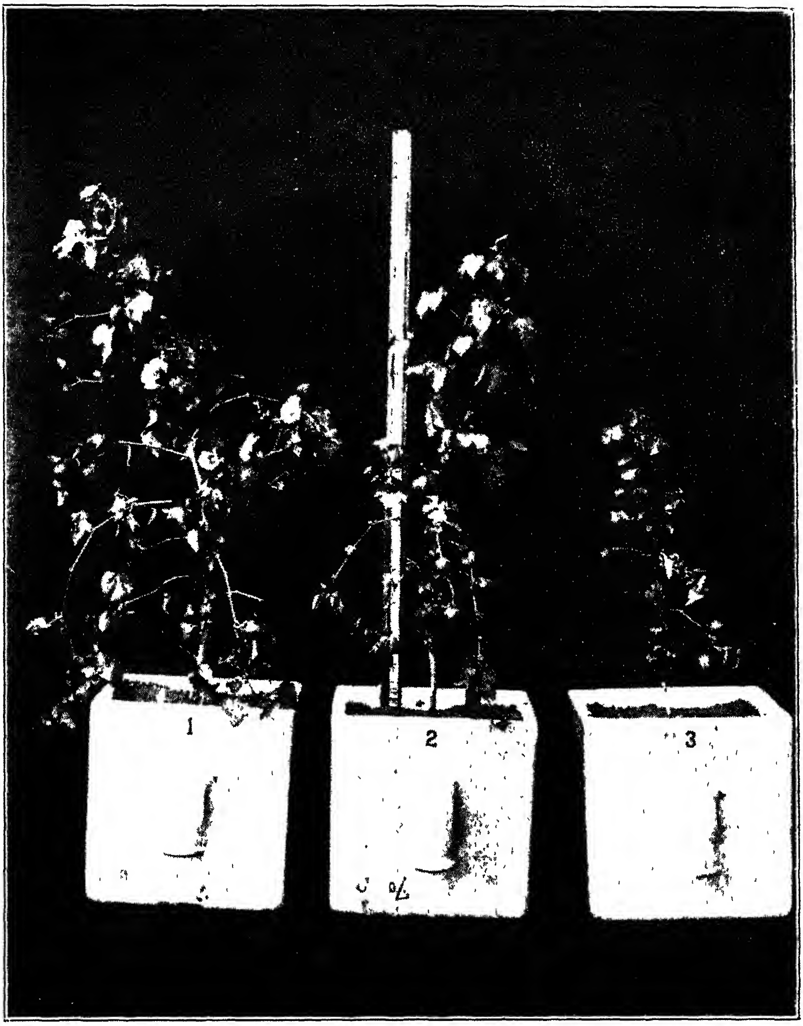

Fig. 1.—Relative Effects in *Gossypium hirsutum* (var. New Amer. Upland) of Plant Irradiation with Ultra-Violet Rays Generated from a M.V.L. for Short and Long Intermittent Durations. Treated Plants are Mainly Characterized by Early Maturity and Dwarf Habit.

1. Control.
2. Five minutes' weekly treatment.
3. Half-hour weekly treatment.

miscellaneous species of parasitic fungi were exposed to varying dosages of these rays and the percentage of residual infection estimated. The experiments being preliminary were undertaken merely to test the effectiveness of irradiation, and not to determine the specific differences in resistance of the parasites. The results are given in Table III.

TABLE III.

FUNGICIDAL ACTION OF THE VISIBLE, ULTRA-VIOLET AND MIXED EXPOSURES UPON INFECTED COTTON SEEDS.

Exposures.	*Survival Per Cent. of the Parasite.*	*Remarks.*
Control (unexposed)	100	Normal germination.
Visible (solar radiation) ..	22-30	Subnormal germination, no injury.
Ultra-violet:		
(1) 5 minutes, from 2 feet distance.	15-20	Germination accelerated, no injury.
(2) 15 minutes, from 2 feet distance.	5-8	Germination accelerated to a greater extent, evidently no injury.
(3) 30 minutes, from 2 feet distance.	2-4	Germination retarded, some injury (external).
Mixed:		
(1) 5 minutes, distance 2 feet.	Nil	Germination retarded, some injury (external and internal).
(2) $2\frac{1}{2}$ minutes (mixed)+$2\frac{1}{2}$ minutes ultra-violet, distance 2 feet.	Nil	Germination accelerated, some injury.
(3) $2\frac{1}{2}$ minutes (mixed)+$2\frac{1}{2}$ minutes ultra-violet, distance of U.V. 2 feet and of I.R. 4 feet.	Nil	Germination accelerated to a greater extent, little injury.

It was observed that after the seeds were exposed for five minutes to ultra-violet rays, only 15 to 20 per cent. of the parasites survived, compared with 100 per cent. in the unexposed checks, irrespective of specific differences. The percentage of killing increased to a still greater extent on an increase in the duration of exposure.

Seeds were completely disinfected after an exposure to mixed radiation. Seed injury in this case was more or less proportional to the intensity and duration of infra-red radiation. Prolonged exposure of seeds to infra-red rays from shorter distances inhibited germination.

Experiments were also conducted, though on a smaller scale, upon the pink bollworm infection in the seed. Over a thousand seeds thus infected were isolated from the stock and placed in the sun for ten hours in the day (7.30 a.m. to 5.30 p.m.). The percentage

of killing did not exceed eighty-seven in the case of seeds exposed only once. A complete killing, however, resulted after a series of three such intermittent exposures. Ultra-violet rays, on the contrary, took only fifteen to twenty minutes to destroy all infection of the lightly diseased seeds. In cases of severe infection, a complete mortality of the larvæ and pupæ could only be secured through mixed irradiation. All doses of five minutes' and longer duration were found to be extraordinarily effective in causing disinfection of such seeds. Detailed investigation in this direction is in progress.

Discussion.

In the present work it has been ascertained that ultra-violet exposures of cotton seed for five to fifteen minutes are useful in inducing increased, earlier and more regular germination. In case of infra-red irradiation the operating temperature (2800° K) is such that the greatest tissue penetration occurs at 10000 A°. It seems, therefore, on account of the great heat engendered, that such exposures were found to be harmful to the germinating power.

The injurious after-effect of infra-red exposures, however, is rendered partially harmless by their combination with the ultra-violet. The combination proved specially useful in cases where the duration and the intensity of infra-red rays are considerably reduced by decreasing the length of exposure and increasing the distance between the source of radiation and the seeds. It may be noted that the latter varies inversely as the square of the distance.

The experiments conducted on diseased material indicate that mixed treatments can profitably be utilized as seed disinfectants. The residual infection in case of ultra-violet exposure was 2 to 4 per cent., which was reduced to nil after receiving the mixed dose. Resistance to killing occurs in cases of deeper infection where the ultra-violet rays are unable to penetrate ordinarily. The rays act only superficially when used without any combination and may therefore be used for surface sterilization of the seeds. Unlike them, the infra-red rays penetrate the tissues deeply. They act as "carriers" to the actinic ultra-violet rays when used in combination, and probably on this account the mixed dosages cause 100 per cent. killing of the parasites.

A combination of ultra-violet with infra-red may replace with advantage the "sun-treatment," wherein the killing effect seems to be mostly due to high temperature, for the ultra-violet component in sunlight at the earth's surface extends to only 313 (less effective

rays) as the lower limit. At several places on the globe, *e.g.* Italian Somaliland,[2] the therapeutic use of solar heat is considered useless, being excessively harmful to the germinating power of the seeds. Treating the problem more scientifically, it is noted that the range of visible radiation varies greatly according to the geographical position and the altitude of the place.* Italian Somaliland is situated in the equatorial belt, and presumably the injurious effect upon seed germination is due to the greater proportion of infra-red; "sun-treatment," therefore, cannot safely be assumed to have universal importance.

Unlike solar radiation, varying proportions of ultra-violet and infra-red can be obtained at will artificially. M.V.L. generates rays down to 240 μ. Fulton and Coblentz[3] found that different wavelength components have different killing power, which increases as wavelength decreases. Radiation generated from a M.V.L., therefore, possesses a relatively violent lethal action accompanied by an acceleration in germination. The range of field of force is greatly increased by the addition of infra-red to these rays.

Conclusions.

Ten hours' exposure of cotton seed to solar radiation, obtained at Benares* during the summer does not significantly influence germination.

Ultra-violet doses of five to fifteen minutes' duration from a M.V.L., operated on 143 watts (130 volts, 1·1 amperes), from a distance of 2 feet initiate increased, earlier, and more regular germination. Longer exposures are decidedly harmful.

Infra-red irradiation from the "Modified Sollux Lamp" causes injury to the seeds and retards germination. Longer exposures of fifteen minutes' duration and more are so harmful as completely to kill the germinating power.

In a combination of U.V. and I.R., the latter possesses a dominating influence. Better germination is only possible when the proportion of I.R. exposure is comparatively low and the seed is at the correct distance.

The U.V. treatment may safely be adopted as a rational measure for surface sterilization of cotton seeds. When the infection is deep, a complete mortality of the parasite is only secured by the combination of U.V. with I.R.

* Benares is situated in latitude 25° 19′ N. and longitude 83° 03′ E., at a height of 267 feet above mean sea-level.

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COTTON STATISTICS

BY

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In the October issue we referred to the extraordinary start which this season had made in regard to cotton supplies when the American crop set up new records in both the August and September Bureaus. These records, however, were completely eclipsed by still further rises in October and November, for the latter carried the indicated crop figure to 18,243,000 bales and the average yield per acre to 258·8 lbs. The crop figure just missed being a record, for in December, 1926, the crop forecast was 18,618,000 bales, though this was actually reduced in subsequent reports to 17,977,000 bales. The December Bureau, however, beat *all* records (except, of course, the acreages) with a crop estimate of 18,746,000 bales, an average yield of 264·6 lb. and incidentally an average bale weight of 518·1 lb. gross against the previous highest of 515·1 in 1933.

But as will be seen from the World's Crops table the extraordinary recovery of the American crop and the consequent drop in prices have not had time to produce what may be regarded as the inevitable reaction on Outside Growths, for the estimates already available of the crops in other countries show further large increases in several cases, and it is probable that the total of Outside Growths this year will be little short of 21 million bales. The first estimate of the Indian crop is not yet available, but two preliminary estimates (of acreage only and not for the whole country) already indicate an increase of 1 per cent. on the acreage, and as the weather has been on the whole favourable with a good monsoon there is no reason to expect that the crop will be less than last year's record yield. Meantime it may be noted that Ralli Bros.' estimate is 7,614,000 bales against 7,773,000 last year. Brazil and Russia are already indicating new record figures, and the Egyptian crop, as will be seen from the next table, is quite evidently going to exceed last year's record figures by a substantial margin, not in acreage (for that was 2,082,420 feddans in 1930), but in the average yield, which is the highest since what may be called prehistoric times, and therefore in the prospective crop. The first estimate for China also showed an increase, but this has now been reduced.

Egyptian Carryover.—The International Federation's half-yearly statistics only came out in time for a brief reference in a P.S. in the October issue. The chief point with regard to the Stocks was that the Mill Stocks outside of the U.S.A. were larger than expected, being in fact a new record for July in the case of Egyptian. In spite of this, however, the World's Carryover of Egyptian cotton at the end of the season showed a further slight reduction from last year's figure, which brings the Carryover down to less than half of the peak figure of July, 1931, and well down to normal figures. But as in the case of the American Carryover, given in October, this movement is likely to be sharply reversed during the coming season, if the big crop estimate is fulfilled.

World's Consumption.—The Federation figures of World's Consumption for the 1936-37 season were of peculiar interest because for the first time there was a serious discrepancy between the Federation figures and Garside's, especially as regards the consumption of Outside Growths. Since then Garside has published revised figures showing American and foreign cottons separately for each of the major divisions of the world, and as his major divisions can be made to correspond with those of the Federation it is of interest to see how the two sets of figures compare. Our next table therefore analyzes the figures for the last four seasons, distinguishing between American and foreign cottons, and it will be seen that as regards American the discrepancy in 1936-37 is not serious and is spread over practically all the major divisions. As regards Outside Growths, however, it will be seen that this season the difference between Garside's figure (now revised to 17,898,000 bales) and the Federation figure (with our additions) of 16,427,000 is largely in Russia. Russia's consumption is, of course, almost entirely her own crop, and it will be noted that Garside's figure of 3,148,000 bales is well up to last year's record figure of the Russian crop, which was reported at 3,550,000 bales. As to the other major divisions, Garside shows a surplus of over 500,000 bales in the Orient and of nearly 300,000 in the U.K., but for all the smaller countries included in "Elsewhere" the Federation figure is fully 400,000 higher than Garside's. It must, of course, be remembered that Garside's figures for foreign cottons are in equivalent bales of 478 lbs. net, while the Federation figures are in running bales, which may account for some of the discrepancies. It is interesting, however, to note that for the Continent, apart from Russia and the U.K., where our figures contain the largest element of estimation, differences are comparatively small.

The importance of all this lies chiefly in its bearing on the

probable consumption for the coming season. On that point the only official figures available are those of the U.S. consumption shown in our next table, and it will be noted that these have so far definitely failed to maintain the high figures of last season. The first two months of the season were fairly satisfactory, for they were still above 600,000 bales, but October showed a heavy drop. Garside has now published figures for August to October of the consumption of American in other countries and the world's consumption of Outside Growths, showing a slight gain in the consumption of American outside the U.S.A., but a larger increase in the world's consumption of Outside Growths. There is therefore no evidence yet of a swing back of consumption from Outside Growths to American.

Prices.—Our next table shows the heavy decline in prices which has been partly the result of the complete change in the world's supply position as the result of the huge American crop. In October this carried American prices down to new low levels since April, 1933, for New York and since June, 1932, for Liverpool. It must, of course, be noted that there have been other factors in the decline, as evidenced by the decline in prices of commodities in general. This has been largely a reflection of the disturbed conditions in America and particularly of the slump on the New York Stock Exchange, which narrowly escaped developing into an absolute panic on October 18. After the October Bureau, however, the cotton market staged a very curious psychological come-back, which was largely due to the feeling that at the new low level of prices a great deal more of the American crop would go into the Government's loan, under which incidentally the terms have been made much more favourable for low grade cotton than they were originally. This recovery, however, proved short-lived, and after the November Bureau prices were back again very nearly to the lowest point. But this again was succeeded by a similar recovery, followed once more by a relapse due to uncertainty as to the action of Congress not only as to crop restriction in future years (the programme for 1938 is already settled under the Soil Conservation Act) but also as to financial and economic legislation generally.

The next table gives the usual details of the spot prices of other varieties of cotton in Liverpool expressed as percentages on American, and it will be seen that these movements have been very irregular, Oomras, Sao Paulo, East African and Tanguis being relatively strong, while Uppers are very weak.

WORLD'S COTTON CROPS.

(Bales of 500 Lbs.—000's.)

	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.	1937–38 *Estimates.*
U.S.A. Lint	13,002	13,047	9,637	10,638	12,399	18,746
Linters	912	982	1,001	1,089	1,350	1,500
Total	13,914	14,029	10,638	11,727	13,749	20,246
Mexico	99	255	223	251	373	326
Brazil	438	1,014	1,359	1,765	1,712	2,000
Peru	237	278	342	396	400	360
Argentine	146	191	295	367	142	
Other South American	39	74	69	86	100	
India*	4,656	5,108	4,857	5,933	6,307	6,250
China	2,195	2,652	3,033	2,410	3,760	3,000
Japan, Korea, etc. ...	133	197	223	254	212	
East Indies, etc. ...	13	15	15	14	16	
Russia	1,776	1,844	1,772	2,347	3,550	3,782
Persia	79	137	200	120	161	
Iraq, Ceylon, etc. ...	†	†	2	4	8	12
Asia Minor and Europe	68	202	263	388	422	
Egypt	991	1,715	1,511	1,707	1,821	
Sudan	110	126	237	199	259	260
East Africa (British)	269	274	273	331	344	
South Africa (British)	2	3	3	2	3	
West Africa (British)...	20	23	47	48	40	
Non-British Africa ...	121	154	165	229	234	
West Indies (British)...	2	3	4	4	4	
West Indies (Others) ...	26	24	31	26	27	
Australia, etc.... ...	11	18	14	14	15	
World's Total ...	25,345	28,337	25,576	28,622	33,659	
Outside Growths ...	11,431	14,308	14,938	16,895	19,911	
Per cent. on Total ...	45·1	50·5	58·4	59·0	59·2	

* Government estimate, 400 lb. bales. † Less than 500 bales.

AMERICAN CROP (EXCLUDING LINTERS).

	1931–32.	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.
Acreage planted (000's)	39,110	36,494	40,248	27,860	27,888	30,960
Acreage harvested ...	38,704	35,891	29,383*	26,866	27,335	30,028
Crop (running bales)...	16,629	12,710	12,664	9,472	10,420	12,142
Yield per acre (lbs.) ...	211·5	173·5	212·7	171·6	186·3	197·9
Season's average spot price (Liverpool—pence per lb.) ...	4·82	5·62	6·02	6·93	6·52	7·12

Progress of the Season 1937–38.

	August.	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*March.*
Acreage planted ...	34,192	34,192	34,192	34,192	34,383	—
Acreage harvested ...	33,429	33,736	33,736	33,736	33,930	—
Crop (500 lb. bales) ...	15,593	16,098	17,573	18,243	18,746	—
Yield per acre (lbs.)...	223·3	228·5	249·3	258·8	264·6	—

* Less 10,396,000 acres special abandonment.

EGYPTIAN CROP.

	1932–33	1933–34.	1934–35.	1935–36.	1936–37.	1937–38.
Area (feddans, 000's) ..	1,094	1,804	1,732	1,669	1,716	1,978
Crop (kantars, 000's):						*December Estimates.*
Alexandria adjusted arrivals	5,050	8,438	7,540	8,375	9,210	10,990
Government figures*	4,956	8,575	7,556	8,535	9,107	11,012
Average yield (kantars per feddan)*	4·53	4·75	4·36	5·11	5·31	5·57
Season's Average Spot Prices (Liverpool—Pence per lb.).						
Sakel	7·79	8·05	8·52	9·22	10·82	—
Premium % on American	38·6	33·7	22·9	41·4	52·0	—
Uppers	7·01	6·64	7·57	7·48	8·46	—
Premium % on American	24·7	10·3	9·2	14·7	18·8	—

* Final revised figures, including Scarto.

WORLD'S CARRYOVER OF *EGYPTIAN* COTTON.

(KANTARS 000's.)

End of	*Stock and Afloat.* U.K.	*Stock and Afloat.* *Conti-nent.*	*U.S.A.* *Mills.*	*U.S.A.* *Ware-houses.*	*Alex-andria.*	*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.*
1931, January	*630*	*293*	*341*	*129*	*5,349*	*6,742*	*1,185*	*7,927*
July ..	600	165	212	108	4,452	5,541	1,418	6,959
1932, January	*1,013*	*248*	*145*	*63*	*5,521*	*6,990*	*1,447*	*8,437*
July ..	885	203	161	180	3,780	5,209	1,553	6,762
1933, January	*878*	*218*	*134*	*171*	*4,255*	*5,656*	*1,425*	*7,081*
July	742	202	131	143	2,228	3,446	1,635	5,081
1934, January	*1,507*	*337*	*142*	*106*	*3,157*	*5,249*	*1,687*	*6,936*
July ..	1,132	248	174	135	1,491	3,180	1,868	5,048
1935, January	*968*	*435*	*132*	*100*	*2,230*	*3,865*	*2,242*	*6,107*
July ..	533	285	130	110	546	1,604	1,965	3,569
1936, January	*690*	*383*	*98*	*87*	*2,368*	*3,626*	*2,078*	*5,704*
July ..	420	233	128	81	619	1,481	1,927	3,408
August	375	158	129	86	489	1,237	—	—
September	338	135	123	76	1,307	1,979	—	—
October	473	247	118	65	2,198	3,101	—	—
November	653	262	111	60	2,691	3,777	—	—
December	795	217	112	54	2,827	4,005	—	—
1937, January	*773*	*270*	*117*	*54*	*2,977*	*4,191*	*2,033*	*6,224*
February	780	315	121	73	2,784	4,073	—	—
March ..	758	255	143	65	2,112	3,333	—	—
April ..	653	240	148	75	1,686	2,802	—	—
May ..	570	187	166	70	1,253	2,246	—	—
June ..	428	135	175	75	770	1,583	—	—
July ..	353	143	160	64	515	1,235	2,062	3,297
August	248	105	146	55	351	905	—	—
September	248	165	122	56	906	1,497	—	—
October	413	270	115	58	1619	2,475	—	—
November	458	180	—	—	—	—	—	—

WORLD'S COTTON CONSUMPTION. FEDERATION *v.* GARSIDE.

American *v.* Foreign by Major Divisions.

Season.		*U.S.A.*	*U.K.*	*Russia.*	*Other Continental.*	*Orient.*	*Elsewhere.*	*World's Total.*
American.								
1933-34	Federation	5,553	1,461	60	3,916	2,238	306	13,534
	Garside	*5,553*	*1,403*	*80*	*4,150*	*2,321*	*273*	*13,780*
1934-35	Federation	5,241	1,049	46	2,736	1,997	285	11,354
	Garside	*5,241*	*941*	*35*	*2,704*	*2,032*	*253*	*11,206*
1935-36	Federation	6,220	1,378	111	2,922	1,793	311	12,735
	Garside	*6,221*	*1,295*	*89*	*2,874*	*1,757*	*267*	*12,503*
1936-37	Federation	7,765	1,262	7	2,516	1,458	338	13,346
	Garside	*7,768*	*1,150*	—	*2,446*	*1,420*	*309*	*13,093*
Foreign.								
1933-34	Federation	116	1,009	1,825	1,671	5,911	1,045	11,577
	Garside	*147*	*1,256*	*1,885*	*1,902*	*5,779*	*853*	*11,822*
1934-35	Federation	96	1,458	1,940	2,600	7,142	1,211	14,447
	Garside	*120*	*1,650*	*1,849*	*2,556*	*7,009*	*1,098*	*14,282*
1935-36	Federation	119	1,355	1,952	2,652	7,210	1,371	14,659
	Garside	*130*	*1,541*	*2,262*	*2,905*	*7,264*	*1,103*	*15,205*
1936-37	Federation	170	1,589	2,188	2,856	8,054	1,570	16,427
	Garside	*182*	*1,887*	*3,148*	*2,909*	*8,593*	*1,179*	*17,898*
All Kinds.								
1933-34	Federation	5,669	2,470	1,885	5,587	8,149	1,351	25,111
	Garside	*5,700*	*2,659*	*1,965*	*6,052*	*8,100*	*1,126*	*25,602*
1934-35	Federation	5,337	2,507	1,986	5,336	9,139	1,496	25,801
	Garside	*5,361*	*2,591*	*1,884*	*5,260*	*9,041*	*1,351*	*25,488*
1935-36	Federation	6,339	2,733	2,063	5,574	9,003	1,682	27,394
	Garside	*6,351*	*2,836*	*2,351*	*5,779*	*9,021*	*1,370*	*27,708*
1936-37	Federation	7,935	2,851	2,195	5,372	9,512	1,908	29,773
	Garside	*7,950*	*3,037*	*3,148*	*5,355*	*10,013*	*1,488*	*30,991*

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(Running Bales 000's: "Foreign" in Equivalent 500-lb. Bales.)

1935-36.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
May	530·8	25·3	518·3	1·4	5·2	5·9	64·7
June	556·3	25·3	542·8	1·4	5·3	6·9	64·0
July	603·2	26·2	588·3	1·8	6·1	7·0	70·2
*Season's total**	6,351·2	—	6,198·5	21·4	67·0	64·3	734·2
1936-37.							
August ...	574·3	27·3	560·3	1·7	5·6	6·7	65·4
September ...	629·7	29·0	613·7	1·7	5·9	8·5	67·9
October ...	646·5	29·7	630·9	1·8	6·0	7·8	72·5
November ...	626·7	30·6	612·0	1·9	5·5	7·3	63·8
December ...	692·9	33·0	676·8	2·0	6·4	7·7	61·9
January ...	678·1	32·7	662·5	1·8	6·5	7·2	63·4
February ...	664·4	33·6	649·0	1·8	6·2	7·5	63·6
March ...	779·3	33·9	759·8	2·2	7·6	9·7	74·3
April... ...	718·9	32·7	700·7	1·9	7·8	8·6	72·8
May	669·5	32·3	652·9	1·5	6·8	8·3	70·5
June	681·4	31·0	662·1	1·5	6·8	11·0	66·6
July	583·1	27·8	569·8	1·0	5·9	12·4	74·5
Season's total	7,944·8	—	7,750·5	20·8	76·8	102·6	817·3
1937-38.							
August ...	604·4	27·5	585·7	0·8	6·4	11·5	72·2
September ...	601·8	27·7	582·8	0·7	6·9	11·4	73·7
October ...	526·5	25·4	511.8	0.7	.7	8.2	72.9

* Revised.

HIGHEST AND LOWEST FUTURES PRICES.

1935–36.	*American.*				*Egyptian (Liverpool).*			
	New York.		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
May ...	11·58	11·02	6·13	5·93	8·68	8·48	7·30	6·95
June ...	11·79	10·60	6·34	5·79	9·20	8·44	7·45	6·84
July ...	*12·78*	11·51	*6·84*	6·23	*11·04*	9·14	*7·92*	7·35
1936-37.								
August ...	12·16	*11·30*	6·53	*6·10*	10·79	9·96	7·49	6·99
September	12·30	11·50	6·68	6·13	10·18	*9·67*	7·32	*6·91*
October ...	12·21	11·51	6·78	6·51	10·80	9·93	7·45	7·14
November	11·92	11·51	6·75	6·46	10·91	9·93	7·36	7·17
December	12·54	11·85	6·89	6·54	10·24	9·80	7·77	7·31
January ...	12·85	12·24	7·15	6·73	10·15	9·83	8·05	7·61
February	12·77	12·36	7·16	6·89	10·15	9·49	8·40	7·83
March ...	*14·70*	12·79	*7·96*	7·18	*12·50*	9·89	*9·73*	8·39
April ...	14·53	12·76	7·94	7·00	12·48	10·60	9·72	8·75
May ...	13·19	12·58	7·33	6·94	11·15	10·36	9·40	8·83
June ...	12·75	11·79	7·14	6·62	9·44*	8·68*	8·48	7·91
July ...	12·58	10·75	6·92	5·93	8·84	7·90	8·42	7·46
1937-38.								
August ...	11·01	9·15	6·06	5·28	7·96	7·35	7·57	6·63
September	9·40	8·15	5·42	4·81	7·63	6·76	6·64	6·00
October ...	8·37	7·50	4·84	4·32	6·86	5·89	6·08	5·31
November	8·12	7·50	4·63	4·34	6·56	6·19	5·73	5·40

Maximum and minimum each season in italics.

* Quotation changed to Giza 7.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (Last Friday of Each Month).

1935–36.	*American (Middling). Pence per lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil.* *Pernam (Fair).*	*Brazil.* *San Paulo (Fair).*	*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
May ...	6·64	72·6	99·2	94·7	99·2	106·0	118·1	113·6	130·6
June ...	7·18	73·8	98·6	93·0	95·8	104·2	115·3	112·3	128·8
July ...	7·10	79·6	97·9	92·3	94·4	103·5	115·5	126·1	158·2
Season's average	6·52	79·9	100·2	96·8	99·7	108·9	116·6	114·7	141·4
1936-37.									
August ...	6·70	74·0	97·0	91·8	94·0	104·5	117·9	117·3	153·4
September	6·73	76·1	99·3	94·1	96·3	106·7	117·8	109·5	150·8
October ...	6·81	74·0	100·3	95·2	97·4	106·9	123·0	106·5	167·6
November	6·72	75·0	98·8	95·1	97·3	107·7	124·1	109·8	170·4
December	7·10	75·4	98 6	94·4	96·5	107·0	125·4	110·3	146·5
January ...	7·34	73·3	98·6	94·6	96·6	106·8	130·7	111·9	139·6
February	7·41	71·0	97·6	92·8	96·2	106·3	130·0	114·3	137·8
March ...	7·95	73·2	98·7	94·3	97·5	106·9	125·8	122·1	159·5
April ...	7·22	74·2	98·6	93·8	97·2	107·6	128·4	128·1	155·1
May ...	7·36	74·3	98·6	93·9	97·3	107·5	127·9	133·0	157·1
June ...	6·95	77·3	98·6	93·5	97·1	107·2	125·9	137·8	144·6
July ...	6·12	75·5	98·0	93·1	97·2	108·7	128·3	142·2	147·9
Season's average	7·11	74·3	98·5	93·7	96·5	106·6	124·3	118·8	152·0
1937-38.									*Giza 7.*
August ...	5·63	78·2	97·3	92·0	96·4	107·1	130·2	136·4	145·3
September	5·08	75·8	97·0	91·1	98·0	107·9	133·5	132·9	151·2
October ...	4·83	77·0	95·9	90·7	99·0	108·3	142·4	129·0	160·9
November	4·64	81·5	96·8	91·4	100·0	109·7	145·3	128·2	153·7

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

1. The following reports have recently been received:
IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.: Rpt. for 1936-37.
INDIAN MERCHANTS CHAMBER: Ann. Rpt. for 1936.
SIND: Ann. Rpt. of Dpt. of Agr., 1935-36.
UNITED PROVINCES: Rpt. on Admin. of Agr. Dpt., 1936.

2. REPORT OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, 1936-37. (Pubd. by Manager of Pubns., Delhi, 1937. Price: R.1 As.2, or 2s.) An account of the work of the year in connection with animal husbandry, the technology of vegetable oils, agricultural research, costs of production of crops, soil science, sugar industry, and locust control.

3. CONFERENCE OF RESEARCH WORKERS ON COTTON IN INDIA. (*Madras Agr. Jour.*, xxv., 7, 1937, p. 199.) The following, among other papers, were read and discussed at the Conference held in Bombay in March last: "The Distribution of *Gossypium* and the Evolution of Commercial Cottons" (J. B. Hutchinson); "Floral Anatomy as an Aid to Classification of Cottons" (P. Abraham and V. R. Ayyar); "The Genetics of *Gossypium* and its Application to Cotton Breeding" (J. B. Hutchinson *et al.*); "Some Aspects of Cotton Breeding Work in India" (V. R. Ayyar); "A Note on Factors in the Acclimatisation of Exotic Varieties of Cotton in Sind" (B. M. Dabral); "The Saline Soils of Sind and the Cotton Plant" (M. A. S. Iyengar); "Cotton Agronomy in Sind" (M. K. Barakzai); "Watering Experiments on Cotton" (M. Afzal); "Effects of Rainfall on the Quality of Indian Cottons" (R. S. Koshal and N. Ahmad); "The Cotton Jassid" (M. A. Husain); "Investigations on Spotted Bollworms in South Gujarat" (B. P. Deshpande); "The Control of Pink Bollworm" (P. B. Richards); "Breeding for Wilt Resistance in Cotton" (B. N. Uppal).

4. INDIAN COTTON: PRODUCTION. By Sir Purshotamdas Thakurdas. (*Cotton Trade J.*, xvii., 18, Internat. Edn., 1937, p. 38. From *Summ. of Curr. Lit.*, xvii., 17, 1937, p. 493.) India produces cotton of various staples and standards of cleanliness, from $1\frac{1}{32}$-inch staple to very nearly the shortest staple grown anywhere. This cotton shows blowroom loss of 6 per cent. in the cleanest variety, up to 16 per cent. in the lower varieties. Punjab and Sind produce long-staple 289F cotton with a staple length of $1\frac{1}{32}$-inch, 4F cotton with a length of $\frac{3}{4}$ inch, and *desi* cotton with a length of only $\frac{5}{8}$ inch. Demand from the United Kingdom, Europe, and Japan has been largely responsible for the mixing of the last two varieties in mixtures ranging from 20-70 per cent. of *desi* cotton. Any reliable shipper in India can, however, supply uniform shipments of pure and unadulterated staple according to buyers' requirements. Complaints of false-packing in the Bombay market are few. According to an Act passed by the Government of India, every bale of cotton must have the distinguishing mark of a particular press on the bale before it leaves the factory, and should any serious flaw be discovered, it is always possible to trace the bale back to the factory where it was pressed. With the extension of cultivation of staple varieties in India, especially in the Sukkur Barrage area in Sind, the possibility of the country supplying long-staple, clean cotton will increase from year to year, whilst exports of short and fair staple cotton will be maintained.

5. Report on the Accuracy of the All-India Cotton Forecasts of 1934-35 and 1935-36 Seasons. (*Stat. Leaflet No.* 5. First issue. Ind. Cent. Cott. Comm., 1937.) The question of improving the accuracy of Government cotton forecasts has been engaging the attention of the Indian Central Cotton Committee through its Cotton Forecast Improvement Sub-Committee, and one of the means adopted is to subject the all-India cotton forecasts of each season to a comprehensive *post-mortem* examination at the close of the season. The summarized results of the examination will be issued annually, and the present report—the first of its kind—is issued in respect of the two seasons 1934-35 and 1935-36.

6. Indian Central Cotton Committee. At the 35th meeting held on August 9 and 10 last, the following, among other important matters, were discussed: The reorganization of the statistical service; a systematic survey of the marketing organization of cotton from raw product to finished cloth; the question of the increased consumption of Indian cotton at home and abroad; the increased production of long-staple cottons. The Progress Report of the Director, Technological Laboratory, was presented, and appreciation was expressed of the work that is being carried out at the Laboratory.

7. Indian Central Cotton Committee. We have received from the Secretary the following notices:

Supply and Distribution of the Various Types of Indian Cotton during the Season 1935-36. (*Stat. Bull. No.* 6.) Deals with statistics of distribution, stocks, exports, mill receipts, etc., of Indian cotton classified by varieties.

Cotton Improvement in Khandesh. This work is concerned with the improvement of the Jarila cotton of Khandesh. The better forms suffering from wilt, attention was devoted to raising a wilt-resistant strain, and work was located at Jalgoan in the wilt area. Strain N.V. 56-3 has so far proved best, but the work is being continued.

8. Indian Cotton. We have received from the Indian Central Cotton Committee a note discussing the question of the alleged unsuitability of Indian cotton to foreign requirements. It is stated that mixing and other evil practices are rapidly being brought under control by means of legislation, and that considerable improvement in the quality of Indian cotton has been effected, though there is still room for further improvement.

9. Spinning Test Reports on Indian Cottons, 1936-37. By N. Ahmad. (*Tech. Circs. Nos.* 308-321, 1936-37. Ind. Cent. Cott. Comm.) The circulars contain the grader's report and spinning test results on Westerns, Northern Cambodia, Navsari, Tiruppur, and Miraj cottons; the report of the Standards Committee and spinning test results on Dholleras, Kumpta, Karunganni, Kalagin, Tinnevelly, and Cambodia cottons; and the report of the Special Appeal Committee on African Cotton and spinning test results on A.R. Jinja, A.R. Busoga, and A.R. Kampala cottons for the 1936-37 season.

10. Indian Cotton Mill: Organization. By D. F. Kapadia. (*Ind. Text. J.*, 47, 1937, p. 253. From *J. Text. Inst.*, xxviii., 8, 1937, A423.) The organization of a mill on 24's, 30's, 40's and 60's is worked out and summarized in a table. The argument is based on the author's equations for optimum drafts at the various processes and on equations connecting optimum production per spindle per day with count. These equations are discussed and reproduced in graphs.

11. Motes in Cotton. II.—Punjab Desi Cottons. By M. Afzal. (*Ind. J. Agr. Sci.*, vii., 3, 1937, p. 451.) The number and position of motes in the locks of the three most important *desi* varieties of cotton—namely, 10 Rosea,

12 Sanguineum and 15 Mollisoni, were determined during 1931 and 1932. It was found that the total number of motes in *desi* cottons was far less in comparison with American cotton, but the disposition of the motes in the various seed positions was very similar. The number of motes was least in the centre of the locks. The early and late pickings had a greater number of motes than the middle pickings. It has been suggested that by far the most important cause of mote production is the defective nutrition of the developing ovules.

[*Cf.* Abstr. 158, Vol. XII., of this Review.]

12. Cotton Cultivation at Coimbatore, Madras. By V. Ramanathan. (*Ann. Rpt. of Cott. Bre. Station, Coimbatore,* 1935-36. From *Pl. Bre. Absts.*, viii., 1, 1937, p. 9.) In the improvement of Cambodia cotton, selection and hybridization of Co.2 with South African cottons (U.4, etc.) and South American cottons (*G. purpurascens* and *G. barbadense*) were pursued. Genetical studies were made on pollen colour, seed and lint weights, boll opening, number of locules per boll, hybrid vigour, natural crossing, and on certain characters induced by X-ray irradiation of seed. In tests of the resistance of American and indigenous cottons to the stem weevil (*Pempheres affinis*), American types were less susceptible than the indigenous cottons.

13. Indore Institute of Plant Industry: Progress Report, 1936-37. *Research work with cotton.* Selection work with cottons from the Shan and Chin States of Burma, and from the frontiers of Assam, Burma, and Bhutan were carried out, and families have been obtained from the material with lint lengths of over 25 mm. and ginning percentage of 35 per cent. The pick of the material has been used in hybridization in connection with the Bengals Improvement Scheme in progress at Sriganganagar.

The principle of basing selection on variance as well as mean values has been exploited by the replicated progeny row technique that has been evolved at the Institute.

In Rajputana trials on different soils with Cawnpore 520, Mollisoni and P289F, indicated that Cawnpore 520 was the most promising cotton. At Malwa trials with sub-strains of Malvi 9 proved that Malvi 20 is definitely superior to Malvi 9 in quality.

A list is given of 31 papers published during the year.

14. Sind: *Cotton Cultivation,* 1935-36. (*Ann. Rpt. of Dpt. of Agr. Sind,* 1935-36.) The irrigation supply in the Barrage area continued satisfactory. The area under cotton on the Left Bank continued to increase, especially under Sind-American varieties. On the whole, however, the season was not a favourable one for cotton; there was considerable boll-shedding, and serious injury from jassid and red leaf disease. Bollworm injury was also reported from Hyderabad. In the northern portion of the Right Bank areas the crop was severely damaged by black-headed cricket, and in some instances it had to be resown.

Research work was continued on the improvement of cottons by selection and hybridization, with a view to evolving strains suitable for late planting and which will be resistant to jassid and to red leaf disease. The introduction of improved methods of cotton cultivation at the Government Farms gave very successful results. The enquiries, financed by the Indian Central Cotton Committee, into the costs of cotton production and the extent of village consumption of cotton in Sind were continued. The Sind Cotton Committee dealt with many important matters during the year, including the control of ginning factory construction in the Barrage areas, the prevention of malaria in the cotton tracts, improvement of official cotton forecasts and the establishment of regulated cotton markets.

15. United Provinces: *Cotton Industry*, 1935-36. (*Rpt. on Admin. of Dpt. of Agr.*, 1935-36.) Improvements in the Bengals cottons have been made, and C520 in particular is rapidly extending. The statement by the Entomological Section that pink bollworm is capable of being controlled by heat treatment of seed in village and factory resulted in the passing of the United Provinces Cotton Pest Control Act to make control operative in selected areas of the province, and thus to improve the quality and yield of the Bengals cottons.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

16. The following reports have recently been received:
Rothamsted Experimental Station: Ann. Rpt. for 1936.
Kenya Colony: 16th Agr. Census, 1936.
,, Ann. Rpt. of Dpt. of Agr., 1936, vols. i. and ii.
Nigeria: Ann. Rpt. of Agr. Dpt., 1935.
Nyasaland: Ann. Rpt. of Dpt. of Agr., 1936.
Sudan: Ann. Rpt. of Dpt. of Econ. and Trade, 1936.
,, Rpt. of Govt. Chem., 1936.
Uganda: Ann. Rpt. of Dpt. of Agr., 1936, Pt. I.
West Indies: *Barbados*, Agr. Jour., vol. vi., 1, 1937.
,, *St. Kitts-Nevis*, Agr. Rpt. for 1936.
,, *St. Lucia*, Res. Abstr. Rpt. of Dpt. of Agr., 1936.
,, *St. Vincent*, Ann. Rpt. of Dpt. of Agr., 1936.

17. Cotton Growing within the British Empire: Continued Progress and Development. By Sir William Himbury. (*Cotton*, M/c, 17/10/37, p. 21.) An interesting review of the progress made in Empire cotton growing in 1936. For the first time production reached over 750,000 bales, a remarkable increase over the previous year. A table is included giving area, population, suitability of soils, production, and quality of cotton for the principal cotton-growing countries of the Empire, followed by a summary of the progress made, and a brief note on the prospects for 1937.

18. Empire Cotton. By L. G. Killby. (*Cham. of Comm. Jour.*, November, 1937, p. 734.) A brief and authoritative report of the continued expansion of cotton growing in the Empire, where the total now exceeds 750,000 bales. Uganda and the Sudan between them continue to produce the greater part of the Empire's cotton outside India, the crops of both countries constituting a record. The Nigerian crop also exceeded 60,000 bales for the first time, and in Kenya the crop has made a remarkable advance in the past few years. The only country in which cotton was a partial failure in the 1935-36 season was Nyasaland. Persistent bad weather not only affected cotton but also the food crops, and to avoid famine the natives rightly gave priority to securing their food supplies, and the cotton was planted too late to give high yields. Exports of Sea Island cotton from the West Indies also showed an increase. The Corporation, among their other activities, continued their investigations on the possibility of devising means for controlling cotton insect pests, and the several aspects of the problem are being studied at their stations in South Africa, Rhodesia, and Nyasaland.

19. The British Cotton Industry Research Association: The Work of the Shirley Institute, Didsbury, Manchester. By Sir Robert Pickard, F.R.S. (*Cotton*, M/c, 17/10/37, p. 30.) An interesting account of the work, which has been a good deal expanded with the opening of the new buildings. The spinning and stapling tests carried out for the Empire Cotton Growing Corporation, the use of the Shirley Analyzer and the Shirley Lint Recoverer, and research in connection with rayon, are briefly discussed.

20. ASIA. CYPRUS: *Cotton Cultivation*, 1936-37. (*Crown Colonist*, October, 1937, p. 520.) A much larger acreage was put under Mesowhite cotton this season, since this cotton did so well in the Limassol district. Some 700 acres of the most suitable cotton land in the vicinity of Episcopi and Colossi are also under this crop.

21. AFRICA. REPORT BY SIR FRANK STOCKDALE, AGRICULTURAL ADVISER TO THE SECRETARY OF STATE FOR THE COLONIES, ON HIS VISIT TO EAST AFRICA, JANUARY-MARCH, 1937. (C.A.C., 345.) A report of a visit made to East Africa with the object of (1) examining the progress made since the last visit in 1930-31 in the development and experiment work of the several Departments of Agriculture; (2) investigating the various schemes of inspecting, grading and marketing agricultural produce; (3) discussing certain matters relating to animal husbandry; and (4) studying in some detail the serious problem of soil erosion. An examination was also made of the work of the East African Agricultural Research Station at Amani.

The report states that the standard of research and investigational work has improved considerably; educational and training schemes have been evolved and are having their effect. Useful work is being done by all Departments of Agriculture in connection with crops grown for food by native communities, but greater efforts are necessary. Greater attention to animal husbandry is desirable, and the development of mixed farming is necessary in certain areas if a reasonable degree of soil fertility is to be maintained. The production of cash crops (particularly cotton) has made remarkable strides in recent years, and the general prosperity of the communities has advanced. On the other hand, in agricultural areas which are densely populated, there are definite signs that the introduction of cash crops into a system of subsistence agriculture is leading to soil exploitation and to a fall in fertility; the marriage of animal husbandry with agriculture is essential if soil fertility is to be maintained. A considerable portion of the report is devoted to the question of soil erosion, and emphasis is laid on the fact that the soil conservation problem is of such pressing importance in East Africa today that definite action must be taken without delay, and the results achieved by control measures in the several territories should be brought under periodic review at the Governors' Conference.

[*Cf.* Abstr. **254**, Vol. XI. of this Review.]

22. COTTON: PRODUCTION IN AFRICAN MANDATED TERRITORIES. By E. Reichelt. (*Wirtschaftsdienst*, **22**, 1937, p. 925. From *Summ. of Curr. Lit.*, xvii., **15**, 1937, p. 425.) Prospects of the cotton-growing industry in Tanganyika Territory, Togoland, South-West Africa and the Cameroons are discussed, and crop statistics are tabulated for these and other recently developed cotton regions in Africa.

23. KENYA COLONY: *Cotton Industry*, 1936-37. (*Ann. Rpt. of Dpt. of Agr.*, 1936, Vols. I. and II., recently received.) Weather conditions were favourable in Nyanza Province, but drought affected the prospects to a serious extent on the Coast and in parts of the Central Province. In spite of this, however, the total yield is expected to reach 22,000 bales. The season opened more favourably than the previous one, prices averaging 13 cents per lb. for first quality at ginneries, increasing later to 14 cents. Three new ginneries were in operation, at Rangala in Nyanza Province, at Lamu in the Coast Province, and Sagana in Central Province. In regard to cotton pests and diseases, sixteen pests were recorded as damaging cotton, the most serious being pink bollworm and stainer. Areolate mildew caused heavy losses in yield in certain areas of the Coast Province, and Fusarium wilt was found in an isolated area. This latter disease is as yet of no economic importance, but precautions are being taken and wilt-resistant

varieties of cotton have been obtained from America for breeding purposes. Details are given of spacing, ratooning, and interplanting experiments, and trials of various strains including U.4 and its derivatives.

The energetic campaign against soil erosion was continued in 1936, and it was gratifying to record that there was increased appreciation of the dangers of soil denudation among European farmers; much, however, still remains to be done in the direction of preserving the soil.

The Cotton (Amendment) Ordinance, 1936, conferred wider powers of control over the cotton industry. It followed the general lines of legislation in Uganda, and enabled the Governor in Council to make rules providing, *inter alia,* for the fixation of minimum prices and the control or prohibition of the movement of cotton from one area to another.

24. *Cotton Prospects,* 1937-38. A report received from H.M. Eastern African Dependencies Trade and Information Office for September states that in some areas prospects are poor due to the dry weather, but in the Coast strip the crop promises well. In the Nyanza Province the crop in some parts is in need of rain, but given normal conditions an increased total yield is probable.

25. *Uses of Cotton Seed.* (*E. Afr. Agr. Jour.*, iii., 2, 1937, p. 90.) Experiments carried out at the Plant Breeding Station indicate that cotton seed can be used as a cattle food; up to 4 lb. can safely be fed to one animal per day. The seed is rolled prior to feeding, but should not be stored for a long time before being used as the oil will tend to go rancid. Excessive use of cotton seed produces a tallowy butter. Some farmers prefer to soak the seed in preference to rolling it, but great care must be exercised if this is done, since cyanogenetic glucosides can be liberated in the process.

26. *Soil Erosion Measures.* (*Crown Colonist,* October, 1937, p. 509.) The Government's scheme to check soil erosion includes surveys of native areas where engineering works in terracing and reconditioning might be necessary. An arrangement is being made with a local firm to operate a terracing unit on farms at a nominal charge to the farmers, the balance being guaranteed by Government, with a view to ascertaining the cost at which such a unit could operate commercially and the extent of the demand for it. Government may also send an officer to the Rhodesias and South Africa to examine local methods of soil preservation.

27. NORTHERN NIGERIA: *Ecological Methods in the Study of Native Agriculture.* By C. G. Trapnell. (*Bull. Misc. Infm.*, No. 1, 1937, Roy. Bot. Gdns., Kew. From *E. Afr. Agr. Jour.*, ii., 6, 1937, p. 491.) A summary of the results of a survey inaugurated in 1931 with the objects of determining and mapping the types of country in terms of their vegetation cover, studying existing agriculture and the natural products found within these types of country, and providing a basis for native agricultural development.

28. NYASALAND: *Cotton Industry,* 1935-36. (*Ann. Rpt. of Dpt. of Agr.*, 1936.) The season was one of the worst experienced for cotton; unseasonable weather conditions, pest injury, and in the Lower River area—where most of the cotton is grown—choice of too early a planting date, all contributed to a very low yield. At the Domira Bay Station of the Corporation, notwithstanding the unfortunate weather experienced, certain quick maturing strains from Gatooma and some early selections made at the Station gave good yields. Experiments in cultivation, manuring, etc., were continued, and the advantages of early weeding of the crop were stressed. Rotation crops, especially maize and groundnuts, did well, but beans were all failures except soya, which showed much promise.

Good prices were paid to the native for his cotton, and he is not easily

depressed by adversity. This year (1937) food supplies are excellent, and there is every indication that there will be an increased seed distribution.

29. *Cotton Prospects*, 1936-37. A recent report from H.M. Eastern African Dependencies, Trade and Information Office, is to the effect that the crop will be a disappointing one. Dull cold weather delayed ripening, and bollworm attack increased in virulence in the Lower River area. Some form of control is necessary, and the need for a real close season is evident. A decrease in the number of insectivorous birds may have some bearing on the increase in noxious insects; the large numbers of such birds which are still caught or their nests destroyed is to be deprecated. Bats also are less in number.

30. *Cotton in the Raw.* By W. Edge. (*Crown Colonist*, November, 1937, p. 545.) A popular article, illustrated, of cotton marketing in Nyasaland.

31. NORTHERN RHODESIA: *New Bridge.* (*Crown Colonist*, October, 1937, p. 512.) The Zambesi crossing at Chirundu is to be effected by a suspension bridge, supported by cables from four high towers. A single span of 1,050 ft. will bridge the river, and with the four approach spans on the southern side the bridge will be nearly a quarter of a mile in length. The roadway will take a double stream of traffic.

32. SOUTHERN RHODESIA: *Notes from the Cotton Station, Gatooma*, 1937. By J. E. Peat. (*Rhod. Agr. Jour.*, xxxiv., **10**, 1937, p. 773.) Notes are given dealing with soil and fertility, seed supply, time of planting, cultivation and spacing, picking, and insect pests.

The Station at Gatooma experienced the best season since its inception, cotton yields averaging 1,000 lb. seed cotton per acre. The author considers that in view of the experience now available more planters should grow cotton as a rotation crop. During the year the Cotton Pest Prevention Act became law, and with the establishment of a "close season" it is anticipated that much less damage to cotton will be caused by bollworms and stainers.

33. TANGANYIKA TERRITORY: *Cotton Industry*, 1935-36. (*Ann. Rpt. of Dpt. of Agr.*, 1936.) Native production of cotton increased in the Lake, Northern and Tanga provinces, and in the Rufiji and Bagamoyo districts of the Eastern province. Cotton in the Tabora district was a failure, but showed promise in the new districts of Singida, Bukoba, and Tunduru. The Southern province was again disappointing, but there are signs of improvement. Estate-grown cotton showed an increase in the Kilosa district and in the Northern and Tanga provinces. The sale of seed cotton by natives during the season gave an estimated return to the growers of £405,500. The two ginnery officers supplied by the British Cotton Growing Association again rendered excellent service. The financial assistance rendered by the Empire Cotton Growing Corporation during years of depression has been of much value to the industry. At the Experiment Stations at Kingolwira, Lubaga and Ukiriguru cotton varietal trials were continued. The work carried out at the various Stations is becoming more and more defined and effective, and of increasing importance to the Territory. During the season under review injury from cotton pests was not unduly serious except in the eastern part of the Territory, where waterlogging and cloudy weather encouraged pest incidence and cotton suffered injury from *Helopeltis* and pink bollworm.

34. *Individual Native Smallholdings.* By N. V. Rounce. (*E. Afr. Agr. Jour.*, iii., **2**, 1937, p. 133.) An interesting account of the "smallholding" system of agriculture that is being established in the Lake province of Tanganyika. The aims are, briefly: to evolve a type of holding which will carry sufficient stock to enable the peasant to maintain his land in a constant state of fertility; to introduce systematic methods by allotting a conveniently shaped holding which

will enable the farmer to keep a ready eye on his crops, and to reduce time lost in going to work; to improve the quality of cattle, so as to afford the farmer a second means of obtaining wealth; to embody in his crop programme a system of crop rotation; to give the native an interest in, and a right to, his land without allowing him to offer it as a security against loans. A plan of a typical holding is included.

35. TOGOLAND: *Cotton Possibilities.* (*Crown Colonist*, October, 1937, p. 513.) In the opinion of experts Togoland, particularly in areas to the north of Atakpame, is capable of becoming an important grower of cotton and with a fivefold increase in production.

36. UGANDA: *Cotton Industry*, 1936-37. (*Ann. Rpt. of Dpt. of Agr.*, 1936. Pt. I.) A record acreage was planted to cotton. The partial failure of germination in July-sown plots was due to the fact that much of the seed had been stored in a damp condition and had heated in bulk. A great deal of replanting had to be done, but eventually a fair stand was obtained. Work on the control of pink bollworm and on wilt disease was continued.

The Committee appointed by the Governor to report on all matters affecting the cotton industry recommended that the Cotton Tax be continued at 2 cents per lb. of lint. Ginners were advised to increase their storage room by 20 per cent., and it was also suggested that the Cotton Ordinance be amended to give power to fix the earliest and latest dates for cotton planting.

37. *Cotton Prospects*, 1937-38. A report from the Department of Agriculture for the month of September states that the acreage planted during the season was larger than that of last year. Owing to dry weather in some areas the condition of the crop is not good, but taking the crop as a whole, the condition is reasonably satisfactory.

38. *Compost Making in Uganda.* By A. L. Stephens. (*E. Afr. Agr. Jour.*, iii., 2, 1937, p. 113.) The method of compost manufacture at Serere is described, giving costs of production and analyses. The system differs from the Indore process only in minor details.

39. *The Vegetative and Nitrogen Efficiency of the Cotton Plant in Uganda.* By H. R. Hosking. (*E. Afr. Agr. Jour.*, ii., 6, 1937, p. 486.) An account of experiments carried out in Uganda with six different strains of S.G. and S.P. cottons to determine the vegetative and nitrogen efficiency of the plants. Tables giving the results are included, and it will be seen that the "vegetative efficiency" —or number of pounds of seed cotton produced by each pound of fresh vegetable matter, other than roots—taken from the plots at the end of the season was found to decrease as the date of sowing advanced, and also with closer spacing. Further experiments are in progress.

40. AUSTRALASIA. QUEENSLAND: *Cotton Industry*, 1936-37. (*Queensland Agr. Jour.*, August, 1937, p. 170.) Considering the extremely dry conditions that ruled throughout most of the cotton areas until December, and the long periods of excessive heat which followed, the quality of the cotton picked this season has been remarkably good. There was considerably less of the yellow-spotted grades, and an increase in the percentage of mature grades, particularly of the newer hard-bodied varieties of medium staple, which are required by Australian spinners.

41. *Grow Cotton.* By R. W. Peters. (*Queensland Agr. Jour.*, August, 1937, p. 175.) A good opportunity is offered by the demand for cotton in Australia. It is managed on a co-operative basis by the Queensland Cotton Board, has great advantages as a rotation crop, and suits the local conditions. For the past

two seasons the average return paid to growers for seed cotton delivered at their nearest railway station has been 4d. per lb., and with the increased demand for cotton this should be maintained for the next three years.

42. FIJI: *Fiji Hybrid Cotton, No.* 172. By C. M. Dass. (*Agr. J. Dpt. of Agr. Fiji,* viii., 3, 1937, p. 18.) Fiji hybrid cotton, No. 172, which has this year been planted on 200 acres, is derived from hybrids of Kidney and Sea Island originally selected by Sir Geoffrey Evans. The various and complex stages of back-crossing and selection are described in detail, and it is considered that "a type of cotton has been evolved which continues the robust habit of the Kidney with the fineness of lint and other good qualities of the superfine Egyptian cotton."

43. WEST INDIES. ANTIGUA: *Cotton Cultivation,* 1936 *and* 1937. (*Rpt. on Agr. Dpt. Antigua,* 1936.) The 1936 crop yielded 117,778 lb. lint, and was sold at prices varying from 1s. 5½d. to 1s. 10d. per lb. for clean lint. Peasants' cotton was again purchased by the Antigua Cotton Growers' Association. The method adopted in recent years of providing pure seed for planting has resulted in improvement in the general quality of the cotton crop. 970 acres were planted to cotton in 1937; germination was fair, but the fields suffered badly from heavy rains later, while much injury was caused by the cotton caterpillar (*Alabama argillacea*).

44. *Observations on Wild Cotton in Birds' Nests in Antigua.* By H. E. Box. (*Trop. Agr.,* xiv., 9, p. 254.) The golden warbler and the yellow-breasted honey creeper, two of the commonest birds in Antigua, use large quantities of wild cotton in the outside make-up of their nests, apparently for ornament. In nests collected two weeks after the Close Season was declared, seeds containing resting stage larvæ of pink bollworm were discovered, and numbers of nymphal and adult stainers were also found. It is clear that the nests of these birds become veritable sanctuaries for carrying over pink bollworm during the close season, for the peak of the nest-building period occurs at a time when the wild cotton is most heavily infested. Further detailed investigations of the subject are needed, and it is also desirable to determine to what extent other birds utilize cotton in the construction of their nests.

45. ST. VINCENT: *Cotton Industry,* 1936-37. (*Rpt. on Agr. Dpt.,* 1936.) Sea Island cotton was planted on 5,294 acres and Marie Galante on 745 acres, compared with 3,540 acres and 721 acres respectively for last season. Weather conditions were not favourable, with the result that growth was checked and there was a tendency for plants to be forced into early maturity. The manuring of cotton fields became more general, and larger applications of cottonseed meal and/or sulphate of ammonia were made by most estate owners. The quantity of manure used by peasants also increased, and in cases where cotton was grown on the share system the cost of the manure was often shared between landlord and tenant.

COTTON IN THE UNITED STATES.

46. THE COTTON SITUATION IN THE UNITED STATES. By A. G. Black. (*Cotton,* M/c, 17/10/37, p. 17.) The estimate of a little over 16,000,000 bales for the present season has already been surpassed. The writer remarks that there is some evidence that the average per-acre yield is increasing in the United States, but statistics are not yet sufficient to justify a positive conclusion. Exports continue to fall, local consumption to increase. The goal under the 1938 agricultural conservation programme has been set at 29,000,000 to 31,000,000 acres to be planted to cotton, compared with 34,000,000 acres in 1937. The Bureau of Agricultural Economics is conducting research with a view to the more accurate determination

of what constitutes quality in cotton, and how to measure it. Grade and staple reports published by the Bureau indicate an improvement in the staple length of American cotton during the last nine years. The average staple length of the 1936 crop was greater than for any other crop since the reports were first published.

The frequent complaints of "false packing" of American cotton caused an enquiry to be made, as a result of which ginneries are being placed under greater control, and the labelling of bales is being introduced. By means of this label that every bale must bear, the ginnery from which it came can be identified.

47. American Cotton Crop, 1936-37. By H. Plauche. (*Cotton*, M/c, 16/10/37, p. 11.) The commercial cotton crop amounted to 14,371,472 bales, compared with 13,321,308 bales in the previous season. In grade the crop averaged about Middling. The staple was good. A greatly improved domestic demand caused an amelioration in general conditions. The consumption of cotton was abnormal, especially in the South where 6,548,000 bales were consumed, this constituting a record. Useful tables are included on production, carry-over, internal mill consumption, exports, etc.

48. World Textiles: with A Review of American Cotton. (Pubd. by *Man. Guar. Coml.*, 8/10/37.) Contains the following, among other interesting papers: "American Cotton on the World Market" (A. H. Garside). Discusses this season's consumption prospects. Uncertainty in the political and economic situation makes prophecy dangerous, but there seems ground to expect that American cotton will at least hold its own in consumption outside America. "The New American Crop" (C. T. Revere). A record yield is anticipated by the author, and this has since proved to be correct.

49. U. S. Yearbook of Agriculture, 1937. (Obtainable: Supt. of Documents, Washington, D.C. Price, $2.00.) This book reports the work of the Committee on Genetics appointed by the Secretary of Agriculture in 1933. The task set for the members was to make a national, and to some extent an international, survey of practical breeding and genetic research with those plants and animals that are important in American farming. The first fruits of the work appeared in the 1936 Yearbook of Agriculture as a series of papers dealing chiefly with the major crop plants and classes of livestock. The present volume covers an enormous and varied field, dealing with garden vegetables, northern tree and bush fruits, sub-tropical fruits, flowers, nut trees, forest trees, forage grasses and legumes, Angora and milk goats, turkeys, ducks, fur-bearing animals, bees, and finally that good friend of the farmer, his dog.

These two genetics Yearbooks have something of the hybrid nature of much of the material with which they deal. They are intended for two groups: (1) Readers who want to know what is going on in the field of plant and animal breeding in order to enlarge their understanding, and to enable them to carry on their farming operations more intelligently; and (2) students and others who have, or expect to have, a closer concern with the science of genetics. Another purpose also underlies this survey of breeding and genetics. It is an attempt to make a frank appraisal of the present situation on a major segment of the agricultural front—not only to sum up achievements, but to expose weaknesses and shortcomings.

50. Agricultural Statistics, 1937. (U.S. Dept. of Agr. Obtainable: Supt. of Documents, Washington, D.C. Price, 50c., paper covers.) This is the second issue of this invaluable publication, prepared under the direction of the Yearbook Statistical Committee. It contains statistics of grains; cotton, sugar,

tobacco; fruits and vegetables; beef cattle, hogs, sheep, horses, and mules; dairy and poultry statistics; statistics of foreign trade in agricultural products; farm business and related statistics; miscellaneous agricultural statistics—forestry, weather, roads, etc. A useful index is included.

51. COTTON REVISIONS: ACREAGE, YIELD, AND PRODUCTION, CROP YEARS 1866-1935. (*U.S. Dpt. Agr., Bur. Agr. Econ., Crop Rptg. Bd.*, 1936. From *Exp. Sta. Rec.*, 77, 1, 1937, p. 123.) Tables prepared by the Crop Reporting Board show for the United States as a whole, by States, and for Lower California by years the acreages of cotton harvested, yields per acre, production of lint cotton and seed, and beginning in 1899 the ginnings reported by the Bureau of the Census.

52. GRADE, STAPLE LENGTH AND TENDERABILITY OF COTTON IN THE UNITED STATES, 1928-29 to 1935-36. (*Stat. Bull. No.* 60, U.S. Dpt. of Agr., Washington, D.C., 1937.) Information is given on the grade, staple length, and tenderability of the annual cotton crop and carry-over.

53. AMERICAN MIDDLING COTTON: WASTE DETERMINATION. By F. H. Martin. (*Cotton*, U.S., 101, 6, 1937, p. 76. From *Summ. of Curr. Lit.*, xvii., 17, p. 495.) Hints are given on the conduct of a waste test in opening, scutching and carding, starting with about ten bales of cotton. An actual record is given of the waste of some 35 points in the opening-carding sequence for South Carolina Middling White $1\frac{1}{16}$-inch cotton.

54. COTTON CULTIVATION IN CALIFORNIA. By A. M. Lesnett. (*Cotton Trade J.*, xvii., 18, Internat. Edn., 1937, p. 127. From *Summ. of Curr. Lit.*, xvii., 17, 1937, p. 489.) Only two areas in California are suited to the growing of cotton, the Imperial Valley in extreme Southern California and the San Joaquin Valley between the Coast Range mountains on the west and the Sierra Nevada mountains on the east. Cotton was first grown for commercial purposes in the Imperial Valley in 1909, when 1,200 acres were planted, a gin was erected, and 350 bales were ginned. The next year the acreage was increased about eight times and 4,000 bales were ginned. In 1914 the estimate was 19,000 bales, and in 1924, 100,000 bales were produced, but since then the yield has decreased owing to depletion of the soil by poor farming methods. The cotton industry in the San Joaquin Valley had its beginning in 1917, and in 1920, 20,000 acres were cultivated. In 1929, 251,500 acres were harvested. The average yield over a period of years is one bale (500 lb. lint) per acre, but the yield is not evenly distributed. Until 1920 Pima (Egyptian) and Upland cotton were about equally divided in the district, but since 1925 Acala cotton alone has been grown. This has a length of $1\frac{1}{8}$ to $1\frac{3}{16}$ inches. The U.S.D.A. Field Station at Shafter in Kern County now provides pure seed stocks of the selected Acala strain. So far, California has not been harassed by the boll weevil and other pests, and every precaution has been taken to keep them out. The necessity of irrigation has made the production costs of cotton greater in California than in the Southern States. In Kern County the world's record production of 650 lb. lint per acre has been established for a large acreage, and on certain quality lands a production of two bales to the acre has been obtained.

55. LOUISIANA: CROPS EXPERIMENTS AT THE NORTH LOUISIANA SUBSTATION. By S. Stewart and R. E. Wright. (*N. La. Sta. Bien. Rpt.*, 1935-36. From *Exp. Sta. Rec.*, 77, 2, 1937, p. 181.) The work included varietal and fertilizer experiments with cotton, seedbed preparation and planting tests, and comparisons of winter cover crops for cotton and corn.

56. GRADE AND STAPLE LENGTH OF COTTON PRODUCED IN 1928-34. By W. B. Lanham *et al.* (U.S. Dpt. Agr., Bur. Agr. Econ., 1936. From *Exp. Sta. Rec.*, 77, 1,

1937, p. 120.) About 77 per cent. of the Louisiana cotton during the period under review was extra white or white in colour and middling or better in grade, and 42 per cent. was 1 inch or longer in staple length, as compared with 69 and 26 per cent. respectively, for the United States.

57. Mississippi Delta Experiment Station: Organization. By M. G. Barnwell. (*Cotton, U.S.*, 101, **6**, 1937, p. 72. From *Summ. of Curr. Lit.*, xvii., **17**, 1937, p. 510.) A brief historical review of work at the Delta Experiment Station, Stoneville, since its foundation in 1904.

58. New Mexico: Field Crops Experiments, 1936. (*New Mexico Sta. Rpt.*, 1936. From *Exp. Sta. Rec.*, 77, **2**, 1937, p. 181.) Includes varietal breeding and fertilizer experiments with cotton; seed treatment and irrigation tests; determination of the grades and staple of New Mexico cotton.

59. South Carolina: Field Crops Research, 1936. By H. P. Cooper *et al.* (*S. Car. Sta. Rpt.*, 1936. From *Exp. Sta. Rec.*, 77, **1**, 1937, p. 39.) Research work on cotton included: varietal and breeding tests; hybridization experiments with Sea Island cotton; fertilizer experiments; seed treatments; studies of variation in fibre length, fineness, and maturity in several cotton varieties.

60. Long-Staple Cotton: Cultivation in South Carolina. By A. B. Bryan. (*Cotton, U.S.*, 101, **8**, 1937, p. 55. From *Summ. of Curr. Lit.*, xvii., **19**, 1937, p. 564.) An illustrated account of the stimulus given to the production of long-staple cotton in South Carolina during recent years. Favourite strains are Coker Wilds, Nos. 2 and 7; the former with a staple of $1\frac{3}{16}$ to $1\frac{1}{4}$ inches, and the latter $1\frac{7}{32}$ to $1\frac{5}{16}$ inches. In 1936, 72 per cent. of the South Carolina crop was of 1 inch or longer cotton, and 94·7 per cent. above $\frac{15}{16}$ inch.

61. Cotton Cultivation in Texas. By V. H. Schoffelmayer. (*Cotton Trade J.*, xvii. **18**, Internat. Edn., 1937, p. 113. From *Summ. of Curr. Lit.*, xvii., **17**, 1937, p. 492.) The Texas cotton yield of 119 lb. per acre for 1936 was one of the poorest in the State's history. The decline was not altogether due to the drought, but slipshod methods of farming robbed the soil of organic matter and fertility, and enabled the drought to do its worst over large areas. Also, undesirable types of short-staple cotton were grown, and this led to a general lowering of the quality of Texas and South-western Uplands cotton. To prevent soil erosion, earthen dams, contouring, and other forms of terracing are suggested, and in addition, crop rotation and the turning under of cover crops of wheat, rye, sorghums, vetch and other legumes are recommended for restoring organic matter to the soils of the South Plains.

COTTON IN EGYPT

62. Cotton Cultivation in Egypt. By M. Messiqua. (*Cotton Trade J.*, xvii., **18**, 1937, Internat. Edn., p. 36. From *Summ. of Curr. Lit.*, xvii., **17**, 1937, p. 489.) Some 1,715,805 feddans were planted in the 1936-37 season, and production is estimated at 9,250,000 kantars exclusive of scartos. There was a substantial decrease in Sakel acreage and a considerable increase in that of Giza 7. This new variety, production of which this year is expected to reach more than $2\frac{1}{4}$ million kantars, thus becomes the most important long-staple strain, and has necessitated the introduction of a new futures contract, which is briefly discussed.

63. Completion of the Gebel Aulia Dam. (*Int. Cott. Bull.*, xv., **60**, 1937, p. 544.) By the completion of the dam, which is over three miles long, and situated 30 miles south of Khartoum, the water stored for the summer will

be increased by about 4,400,000,000 cubic metres. With this tremendous increase in water available there will be over 100,000 acres brought under cultivation, and irrigation in other places will be improved.

64. Egyptian Cotton Crop: Classification by Staple. (*Internat. Rev. Agr.*, **28**, 1937, 422S. From *Summ. Curr. Lit.*, xvii., **17**, 1937, p. 494.) A table is presented which shows a classification of the Egyptian cotton crop according to staple length during the last five seasons by bales (478 lb.) and acreage.

65. A New Super Quality Egyptian Cotton. (*Text. Wkly.*, xx., **502**, 1937, p. 483.) A new high-quality variety known as Giza 26 has claims to be the best spinning cotton ever grown in Egypt. The cotton is at present selling around Sakel prices, but is said to produce a much stronger and more regular yarn than Sakel at its best. The staple is appreciably longer than Sakel, being a full 1⅝ inches, and is more lustrous and of darker shade. There would appear to be little difficulty in spinning Giza 26 well above 150's. This strain makes its appearance on the official list of cottons for the first time this season; the crop is only around 1,200 bales, but if the early promise is fulfilled, it may be expected to increase rapidly in the near future, replacing Sakel.

66. Giza 27: A Wilt-Immune Strain of Long-Staple Cotton. By T. Fahmy. (*Tech. and Sci. Serv. Bull., No.* 176. Min. of Agr., Egypt, 1937.) It has been possible to isolate a genotype immune strain from an immune by susceptible cross. This strain has a superior lint quality but a lower yield than its immune parent, Giza 7, though heavier than that of the susceptible parent, Sakha 3.

To judge its possible relative economic merits a few words are necessary as to the existing competing Egyptian cotton varieties.

Sakel, the once reputed and most widely grown fine Egyptian cotton, is gradually dying out, and in a few years will have disappeared. It is very susceptible to wilt and of low yield, and cannot compete with Sakha 4, a wilt-immune long-staple variety selected some ten years ago. This strain is becoming a favourite in some localities where Sakel was the principal variety, since it gives the same if not slightly superior yield to Sakel on non-wilt infected land, and a far better crop on wilt-infected land where Sakel is practically destroyed.

Giza 7, one of the parents of the isolated strain, is an immune cotton of medium staple, and though of lesser quality than Giza 27, it is a serious competitor because of its heavier yield.

Giza 12, a Botanical Section selection, originally from an Ashmouni by Sakel cross, is a heavier yielder than Giza 7, but is slightly inferior to it in quality.

The position of Giza 27 at present is uncertain, for though of better quality, it has to compete with Giza 7 which has greater yield. If, however, Giza 7, which will have to compete with Giza 12, is driven out of cultivation by the latter, Giza 27 will have a better chance because of the wider gap in quality between it and Giza 12, and might then be in demand.

67. Experiments in Egypt on the Interaction of Factors in Crop Growth. VII. The Influence of Manuring on the Development of the Cotton Crop. By F. Crowther *et al.* (*Bull. No.* 31. Tech. Ser., Roy. Agr. Soc., Egypt, 1937.) The data for the development of the cotton crop, derived mainly from ten experiments, five in 1935 and five in 1936, are described. The experiments dealt with the influence of manuring on fruit production, dry-matter production, and absorption of nitrogen by the crop.

Whatever the variety, spacing, or general yield level, effects of nitrogenous manuring were clearly discernible in the larger plant structures and in the larger and more numerous bolls borne in the middle and upper zones. Increases in dry matter became more marked as the season progressed. Phosphate effects

were smaller and were observed less frequently; they were confined mainly to slight increases in dry matter, particularly at close spacing, and to change in boll size.

Water-table readings taken at the various experiments during the cotton season showed a wide variation in mean depth below the soil surface, ranging from about 70 cm. to 200 cm. By chance the two experiments with the highest water-table gave the greatest yields of cotton, showing that large yields are at least possible where the water-table is high.

68. Experiments in Egypt on the Interaction of Factors in Crop Growth. VIII. Manuring of Cotton in Egypt. By F. Crowther *et al.* (*Bull. No.* **32**, Tech. Ser., Roy. Agr. Soc., Egypt, 1937.) Summarizes the work of the Joint Agricultural Research Scheme, details of which are contained in Bulletins I. to VII. of " Experiments in Egypt on the Interaction of Factors in Crop Growth."

[*Cf.* Abstrs. **494, 568,** Vol. XIII.; **214, 215, 595,** Vol. XIV.; and **67,** Vol.; XV., of this Review.]

COTTON IN OTHER FOREIGN COUNTRIES.

69. Cotton Growing in Ethiopia. (*Int. Cott. Bull.*, xv., **60,** 1937, p. 508.) It is expected that Abyssinia can grow good American cotton to the extent of about 900,000 quintals yearly, which would be almost sufficient to supply the Italian mills.

70. Cotton Cultivation in South America. By C. R. Fix. (*Cotton Trade J.*, xvii., **18,** Internat. Edn., 1937, p. 42. From *Summ. of Curr. Lit.*, xvii., **17,** 1937, p. 491.) Production of cotton in South America has increased rapidly since 1932, and in 1935-36 the total yield in Latin America, including Mexico, was some 2,900,000 bales, or 60 per cent. more than the Egyptian crop and almost one-fourth the size of the American crop of the same period. Rapid progress has recently been made in Brazil, especially in São Paulo and adjacent southern states, but in the north progress is hampered by antiquated agricultural methods, obsolete gins, droughts, and lack of labour. Measures taken by the Brazilian Government to encourage cotton cultivation, and the influence of world trade relationships, tariffs, import restriction schemes, Japanese competition, German barter agreements, etc., on the Brazilian cotton trade are discussed. Acreage, yield, import, and export figures are also given. In Peru, Tanguis is the principal variety of cotton grown. Cotton cultivation in the Argentine has developed rapidly since 1919, and over 325,000 bales of 500 lb. were produced in 1935-36. Eighty per cent. of the cotton is produced in the Chaco territory, where yields of over 235 lb. per acre can be obtained without the help of fertilizers.

71. Argentina: *Cotton Industry,* 1936-37. (*Int. Cott. Bull.*, xv., **60,** 1937, p. 503.) The drought has caused a severe setback to the Argentine crop, which is now estimated at 189,000 bales against 367,000 bales in 1935-36. The total value, however, is expected to be greater owing to the rise in prices.

72. *Memoria Anual de la Junta Nacional del Algodon,* 1936. (Buenos Aires, May, 1937.) This is the first report to cover a complete agricultural year. The value of the production of cotton in Argentina is 70 millions of pesos, exceeding that of sugar or maté, and it is rapidly increasing; 81,000 tons were produced in 1935-36, and a further increase of 30 per cent. is expected this year. Selection of seed, largely among varieties imported from the United States, is vigorously pursued at the Experiment Stations, and aims at present at a minimum length of 25 mm. and a ginning percentage of 30. Acala, Carolina Foster, and Lightning Express are the best cottons up to date. Maps of distribution

of seed are given. Ecological studies of climate and soil tend to show that the conditions for successful cultivation are less narrow than is often supposed. Other matters discussed include legislation, colonization of the new land available, credit, co-operative societies, and the work of the district agricultural officers.

73. Belgian Congo: *Compagnie Cotonnière Congolaise.* The report for 1936 is a record of a successful year. Production reached 54,802 tons, compared with 44,062 tons in 1935; 78 ginneries were in operation during the period under review.

74. *Les Caracteristiques du Cotonnier au Lomami.* By Mme. D. Soyer. (*Ser. Tech. No.* 16, Inst. Nat. pour l'Étude Agr. du Congo Belge, 1937.) This paper contains careful statistical observations upon five cottons: Mebane, or Triumph Big Boll, Bambesa (local, originally derived from Triumph Big Boll), Gandajika (descended from Bambesa seed taken to Gandajika in 1928), Delfos (selected at Delta, Mississippi, from a field of Foster 120), and U.4 (seed direct from Barberton). The author considers that U.4, after thorough acclimatization, should be capable of furnishing lines that may supersede the present cottons, on account of the length of its fibre (at present irregular), its resistance to insects and disease, and its yield. Delfos, on the whole, comes second, while since 1928 Bambesa has greatly improved at Bambesa and remained stationary at Gandajika.

In the statistical tables U.4 is the shortest of the five cottons, but reaches its maximum height in four months against six for the others. Its leaves and bolls are the smallest; seed weight per boll is again the least (4·94 against an average of 7·24 for the rest); its percentage of fibre is 33·80 against an average of 37·50, but the length of the fibre is 28·33 against an average of 25·06. The number of flowers per 100 plants is all but double that of Gandajika the next best, and so is the daily mean number. The boll develops in 36 days from flowering, against 34 for all the rest. In resistance to aphis U.4 is about average; to *Lygus* it is about the best; to jassid much the best. Finally, the average yield of cotton was 643 kg. per hectare for U.4, 580 for Gandajika, and so on down to 293 for Mebane. The value of Delfos was slightly higher, but U.4 was second.

75. Brazil: *Cotton Industry,* 1936-37. (*Int. Cott. Bull.,* xv., **60,** 1937, p. 504.) As classification of the 1936-37 crop proceeds in São Paulo there is apparent a marked deterioration in quality due to the heavy rains. Attempts are being made to substitute more resistant varieties of cotton. The total outturn is expected to be below 200,000 tons.

Prospects for the 1937-38 crop in Pernambuco are said to be excellent both in quality and quantity.

76. *La Situacion Algodonera en el Estado de São Paulo, Brasil.* (*Bol. Mensual,* No. 24, Min. de Agr., Junta Nac. del Algodon, Buenos Aires, 1937.) Coffee occupies the chief place in São Paulo agriculture, with 1,967,000 hectares, but cotton is now fourth, with 295,000 hectares. A general account is given of the cotton industry and the method of cultivation.

77. *Expansão da Lavoura Algodoeira no Brasil.* By Dr. B. Kitamura. (*Ouro Branco,* Brazil, ii., **12,** 1937, p. 14.) A discussion of the effects of Japanese labour in the cotton fields of Brazil; 37·8 per cent. of the labour in the cotton fields of São Paulo is Japanese.

78. *Uma Questão importante em Torno do Nosso Algodão.* By A. de Noronha. (*Ouro Branco,* Brazil, ii., **11,** 1937, p. 16.) The main cause of the inferiority of

much Brazilian cotton is stated to be injury from pests, and methods of pest control are discussed.

79. Cotton Cultivation in French African Colonies. By M. M. Simon. (*Cotton Trade J.*, xvii., **18**, Internat. Edn., 1937, p. 34. From *Summ. of Curr. Lit.*, xvii., **17**, 1937, p. 489.) The production of cotton in French Colonial Territories was 28,000 quintals in 1934, 63,000 quintals in 1935, and 53,000 quintals in 1936. Morocco produced 350 quintals in 1934, 800 in 1935, and a further increase of 10 per cent. in 1936. Pima 67 is the strain cultivated. The production of lint cotton in Western French Africa reached 45,000 quintals in 1935 and 1936, compared with 25,000 in 1934. The Experiment Station at Sokolo was able to obtain from certain varieties of American seed a production of from 2000/2400 kg. gross per hectare, with a yield of 33 per cent., or on an average 700 kg. of fibre. A further increase in the cotton acreage is expected when the Sansanding dam is completed. In French Equatorial Africa production has increased steadily from 9,000 quintals in 1931 to 80,000 quintals in 1936.

80. Cotton Cultivation in Mexico. (*Cotton Trade J.*, xvii., **18**, Internat. Edn., 1937, p. 51. From *Summ. of Curr. Lit.*, xvii., **17**, 1937, p. 490.) Various estimates of the 1936 crop place it at from 250,000 to 275,000 bales. The conditions, production, and character, grade and staple of the crops produced in the different regions of Mexico are discussed.

81. Cotton Cultivation in Russia. (*Cotton Trade J.*, xvii., **18**, Internat. Edn., 1937, p. 40. From *Summ. of Curr. Lit.*, xvii., **17**, 1937, p. 491.) The Soviet Second Five-Year Plan announced in 1932 called for a cotton crop of 2,125,000 tons in 1937. The 1936 crop amounted to 2,272,800 tons of raw cotton. Improvements in quality are reported, and more than 80 per cent. of the cotton purchased by the State consisted of selected and first grades. A distinctive feature of the 1936 season was the continued development of large scale, completely mechanized farming methods.

82. Russia: *New Long-Fibre Cotton.* (*Int. Cott. Bull.*, xv., **60**, 1937, p. 513.) The Central Selection Station of the All Union Cotton Research Institute has evolved a new long-fibre, early ripening variety of cotton with large bolls. This is claimed to be the first time that early ripening cotton combines a large boll with fibre over 30 mm. long. Several varieties have been produced, and these will be used to replace the small boll varieties still being grown on thousands of acres in the country.

83. Cultivation of Cotton in Spain. By E. Martinez de Bujanda. (*Mo. Bull. Agr. Econ. and Soc.*, 27, **2**, 1936, Rome, p. 60. From *Exp. Sta. Rec.*, 77, **2**, 1937, p. 261.) The governmental measures for promoting cotton growing in Spain are briefly described.

SOILS AND MANURES.

84. Essays in Applied Pedology. By G. Milne. (*E. Afr. Agr. Jour.*, iii., **1**, 1937, p. 7.) Pt. I. deals with Soil Type and Soil Management in Relation to Plantation Agriculture in East Usambara, Tanganyika Territory.

85. Soil Deterioration and Soil Conservation from the Viewpoint of Soil Microbiology. By S. A. Waksman. (*J. Amer. Soc. Agron.*, 29, **2**, 1937, p. 113. From *Exp. Sta. Rec*, 77, **1**, 1937, p. 18.) A decrease in the organic matter content of the soil accompanies soil deterioration and is in itself a cause for further deterioration of the soil, while an increase of the content of organic

matter and nitrogen is a symbol of soil improvement. Furthermore, soil erosion results in the loss of the "active" or "living" surface layer of the soil, leaving the "dead" subsoil. The latter, because of lack of aeration and lack of sufficient nutrients, limits the growth of the important micro-organisms. The soil may also become infested with pathogenic organisms as a result of certain systems of cropping, thus leading to a condition which characterizes "sick" or "exhausted" soils. This condition can be prevented or corrected by proper systems of crop rotation and soil improvement. Soil conservation must keep a proper balance of the microbiological population of the soil and a proper state of microbiological efficiency.

86. On the Formation of Structure in Soils. By D. I. Sideri. (*Soil Sci.*, 42, 1936, pp. 381, 461. From *Exp. Sta. Rec*, 76, 5, 1937, p. 592; 77, 1, 1937, p. 16.) I. *The structure of soil colloids.* "The existence of aggregate phases in soil colloids alters essentially our conceptions regarding their behaviour. The electric properties of colloid particles, when they agglomerate into groups, are radically changed as a result of the shrinking of the ion envelope. The properties determined by the nature of the absorbed cations are levelled out in the associated groups. The possibility of spontaneous coagulation, explained by the prevalence of the forces of molecular attraction over those of electrostatic repulsion, is demonstrated."

II. *Synthesis of aggregates; on the bonds uniting clay with sand and clay with humus.* Carrying forward experimental work noted above, the author has found evidence supporting a new theory of structure formation based on the capacity of soil colloids to form phases of the aggregate state. "The former conception that the particles forming the soil structural aggregate are held together by the tension of the water film is supplemented by the finding that the surface film creates a definite orientation of the particles in relation to one another. The tenacity of the bond between the separate parts of the soil structural aggregate cannot be explained by the presence of absorbed Ca. The explanation of the tenacity of this bond lies in the stability of the group arrangement of the particles. The most stable arrangement of particles is the homogeneous one. The formation of non-homogeneous aggregates in soil—sand clay and clay humus—may be explained by the same laws which have been found to exist for mineral intergrowths. The impossibility of completely separating soil into its elementary parts is corroborated. In connection with the theory developed, it becomes necessary to revise the theory of soil texture. The subdivision of soil into stable and unstable groupings of particles appears to be more expedient. The influence of external conditions (vegetation, micro-organisms, tillage, pressure, freezing, etc.) on the formation of structure can be explained by the swarm theory."

87. A New Method for Determining the Porosity of the Soil. By G. Torstensson and S. Eriksson. (*Soil Sci.*, 42, 6, 1936, p. 405. From *Exp. Sta. Rec.*, 77, 1, 1937, p. 16.) A description of a "porosimeter," by means of which the air space in a soil sample may be determined by an application of Boyle's law. A lettered diagram shows the nature and function of each detail of the apparatus, which is also shown as a whole in a photograph. The simple calculation involved is illustrated by a literal solution.

88. How Man makes Deserts: Soil Erosion in the British Empire. By E. Huxley. (*Times Wkly. Edn.*, 17/6/37.) A useful paper dealing mainly with soil erosion in Africa, and particularly with Kenya.

89. Some Important Soil Groups of Ceylon. By A. W. R. Joachim. (3rd. Int. Cong. Soil Sci., Oxford, 1935. From *Exp. Sta. Rec.*, 77, 2, 1937, p. 162.) The major soil groups of the island are discussed: the laterite soils, the red and

yellowish lateritic and non-lateritic earths; soils similar to the Terra Rossa soils; the mountain steppes (Patanas); soils derived from Pleistocene and recent deposits; and the paddy (Gley) soils.

90. THE PRESENT DEVELOPMENT OF SOIL STUDY IN CHINA. By T. Y. Tang. (3rd. Int. Cong. Soil Sci., Oxford, 1935. From *Exp. Sta. Rec.*, 77, **2**, 1937, p. 157.) The author states that "about the year 2210 B.C., Da Yu, the first emperor of the Hsia dynasty, took up the study of the soils of nine territories and classified them according to their colour, texture, geographical features, and productivity for the purposes of evaluation and assessment of land taxes. Although the classification can hardly be regarded as scientific from the modern pedological standpoint, still it must be considered remarkably comprehensive and systematic for that early period when scientific knowledge was so limited." Recent soil studies have been of limited extent and mostly confined to fertility questions. A comprehensive study of the soils of China was begun, however, in 1930, and the progress of this work is outlined.

91. SOIL DETERIORATION IN THE CANAL IRRIGATED AREAS OF THE PUNJAB. By E. McKenzie Taylor, A. N. Puri, and A. G. Asghar. (*Punjab Irrigation Res. Inst. Res. Pubns.*, iv., 7, 8.) Pt. I. deals with the equilibrium between calcium and sodium ions in exchange reactions in the soil. Pt. II. discusses the relation between the degree of alkalization and the dispersion coefficient in deteriorated soil.

92. SOME OBSERVATIONS ON THE SOILS OF TROPICAL AFRICA. By C. G. T. Morison. (3rd. Internat. Cong. Soil Sci., Oxford, 1935. From *Exp. Sta. Rec.*, 77, **2**, 1937, p. 161.) "It was found possible to delimit the area into three important units, in the first of which the rainfall was about 250 mm. (10 inches) per annum and fell in the months of August and September. In the second area the rainfall averaged 760 mm. and occurred in the months of July, August, and September. In the third area the rainfall was from 1,500-2,000 mm. and fell in the six months from April to September. It was also found possible to distinguish certain main types of soil and their associated vegetation which appeared to persist throughout the three regions, and from which it was consequently possible to deduce certain general statements with regard to tropical soil." Certain main factors upon which the nature of the soils is held to depend and topographic characteristics of the terrain are indicated, and the general outline of the classification scheme is presented.

93. SELENIUM IN PLANTS IN RELATION TO ITS OCCURRENCE IN SOILS. By J. T. Miller and H. G. Byers. (*J. Agr. Res.*, 55, **1**, 1937, p. 59.) A report of studies carried out in Kansas, Colorado, and New Mexico. Great variation occurs in absorptive capacity of plants for selenium. A plant of *Astragalus bisulcatus* absorbed 1,100 parts per million of selenium, while wheat growing with it absorbed only 45. Hydrogen-ion concentration does not appear to be an important influence in relation to selenium absorption.

94. TOXICITY OF SELENIUM TO PLANTS AND ANIMALS. By A. L. Martin. (*Amer. J. Bot.*, 23, **7**, 1936, p. 471. From *Exp. Sta. Rec.*, 77, **2**, 1937, p. 173.) Injury to rats resulted from diets containing ground stems, leaves, and seeds of seleniferous buckwheat grown in field cultures, the degree depending on the concentration in the plants. Small amounts stunted growth, while high concentrations were quickly lethal. Selenium proved more poisonous to the animals than to the plants. Buckwheat exhibiting no symptoms except for slight dwarfing contained enough poison, even when diluted with an equal part of a grain diet, to cause death in rats within nine weeks. Soil analyses of

artificially selenized field cultures at the beginning and end of a 13-month interval indicated that moderate rainfall and cropping had very little effect in reducing the selenium content.

95. FERTILIZER EXPERIMENTS WITH COTTON ON HEAVY IRRIGATED SOILS. By G. Staten and D. A. Hinkle. (*Bull.* 248, Agr. Exp. Sta., New Mexico Coll. of Agr., 1937.) On the heavy soil that was used for the experiments during eight years (1929-1936 inclusive) annual applications of 135 lb. of superphosphate per acre, 150 lb. of ammonium sulphate per acre, and a combination of 135 lb. superphosphate and 150 lb. ammonium sulphate per acre did not significantly affect the annual average yield of lint cotton, the staple length, lint percentage, boll size, or maturity, when compared with no-fertilizer plots.

Annual applications of barnyard manure at the rates of $6\frac{1}{4}$ tons per acre from 1929-1932 inclusive, and $8\frac{1}{2}$ tons per acre from 1933-36 inclusive, increased the average annual yield of lint cotton by 118 lb. to the acre; increased the staple length by almost $\frac{1}{32}$ inch as determined by a Government classer; produced a slightly larger boll; delayed maturity, increasing the percentage of late-picked cotton by 5·6 per cent., when compared with no-fertilizer plots. None of the fertilizer treatments appeared to have any effect on the prevalence of *Verticillium* wilt in the experimental plots.

96. SOME ASPECTS OF SOIL EROSION CONTROL IN THE UNITED STATES. By H. Kohnke and J. S. Cutler. (3rd Int. Cong. Soil Sci., Oxford, 1935. From *Exp. Sta. Rec.*, 77, 2, 1937, p. 163.) The authors, both of the U.S. Soil Conservation Service, summarize the present erosion situation in the States in the statement that " it may be said that the safe use of land in different areas depends upon the productive capacity and the slope of the land. In general, the more gentle slopes can be economically protected from excessive erosion by purely agronomic methods, such as fertilization, planned crop rotations, strip cropping, and contour tillage, or by the use of terraces. The steeper lands can be economically utilized as meadow or pasture, while the excessively steep slopes can best be devoted to forest, climatic conditions permitting, or to pasture. Farm management studies have shown that the adoption of erosion control methods will result in no immediate loss of return, and over a period of years will actually increase the income of the farmer."

CULTIVATION, IRRIGATION, GINNING, ETC.

97. ECONOMICS OF AGRICULTURE. By A. P. van der Post. (*S. Afr. Agr. Ser.*, vol. 15, 1937. Pubd. by Central News Agency Ltd., Johannesburg. Price 25s. in S. Africa.) A reasoned application of the science of economics to the agricultural industry. The origin and development of agriculture, and the factors that are operative, are considered. Capital and land, two of the most important factors in agricultural development, are dealt with in detail, and a third great factor, transport, is also considered. The author discusses the uneconomic use of capital upon small holdings as compared with larger, though the former have certain social and political advantages which have caused a movement in their favour, in spite of the fact that the tendency would be to stabilize agriculture at an uneconomic level of progress. Marketing is discussed in full detail, and a good word is said for the middleman and for co-operative associations. International trade is dealt with, with the arguments for and against protection. The book ends with a consideration of trade cycles, farm relief, and other matters. It is lucidly written, and is a very good presentation of agricultural economics.

98. The Scientific Basis of the Art of Cultivation. By B. A. Keen. (*Pro. and Papers of 2nd Conf. on Mech. Farmg.*, Oxford, 1937. From *Rpt. for* 1936, Rothamsted Exp. Sta.) The capillary-tube theory of water movement in soil, which has long been used to explain the control of soil moisture by cultivation operations, is shown to be erroneous. The pore-space of the soil must be regarded as a series of cells communicating with one another through relatively narrow necks. The boundaries of these cells and necks are formed by the soil aggregates or crumbs, which can be likened to small sponges. The crumbs imbibe water from the rain that percolates down the pore-space, and water is held at the points of contact of the crumbs and also partially fills the pore-spaces. Any surplus drains away and eventually reaches a water-table. When drying conditions occur at the surface, evaporation proceeds by the progressive downward drying of the top layers of crumbs rather than by the upward movement of water from below to the surface. In other words, most soils are naturally "self-mulching." Similarly, when root hairs absorb water, inward movement to the region of absorption will be very slow and over very limited distances. The water held by the soil is to be regarded as relatively static; modern theory shows, in fact, that it resists movement.

The effects of soil water content and movement attributed to operations such as harrowing and rolling are therefore much less than the old capillary theory asserted. The main function of cultivation is not to exercise a delicate and precise control of soil moisture, but to remove the competition of weeds, to obtain a seed-bed of suitable consistency, and to prevent crusts or "caps" forming on certain classes of soil.

99. The Technique of Modern Field Experiments. By E. M. Crowther. (Reprinted from *J. Roy. Agr. Soc. of Eng.*, vol. 97, 1936.) Discusses early work on the subject; fertilizer experiments on the Continent; yield trials of varieties; the introduction of statistical methods; randomized experiments and the analysis of variance; factorial experiments; crop sampling and forecasting; multiple experiments.

100. Statistical Data: Tests of Goodness of Fit. By J. B. S. Haldane. (*Biometrika*, **29**, 1937, p. 133. From *Summ. of Curr. Lit.*, xvii., **16**, 1937, p. 487.) Exact values of the moments of the distribution of x^2 used as a test of goodness of fit are obtained, which enable the test to be applied when the numbers expected in an observation are small.

101. The Design and Analysis of Factorial Experiments. By F. Yates. (*Tech. Commn. No.* 35, Imp. Bur. of Soil Sci., Rothamsted, 1937.) Factorial experiments are experiments which include all combinations of several different sets of treatments or "factors." Information is thus simultaneously obtained on the responses to the different factors, and also on the effects of changes in the level of each factor on the responses to the others. The author has not written this paper with the object of convincing experimenters of the need for employing factorial designs, but rather for those who, while fully conscious of the advantages of such designs, find difficulty in laying them out and in analysing the results. It is, in fact, an attempt to give a comprehensive survey of the simpler types of design at present available, and a description of the appropriate methods of analysis.

102. The Effect of Exposure in the Field on Grade, Strength, and Colour of Raw Cotton. By M. A. Grimes. (*Texas Sta. Bull.* 538, 1936. From *Exp. Sta. Rec.*, 77, 1, 1937, p. 41.) Ferguson Triumph 406 cotton, grown in 1931-32 at Temple, Chillicothe, and Lubbock, was picked after opening, and after intervals of exposure ranging from 1 to 33 weeks, and after ginning and classing, strength determinations and colour analyses were made.

A drop of one grade occurred after one week of exposure at one station, and after an average of less than four weeks for all stations and seasons. A drop of 4 and 5 grades, a decrease of from $\frac{1}{16}$ to $\frac{3}{16}$ inch in length, and a decrease in price of from 150 to 265 points occurred during exposure. The loss due to exposure was in some cases nearly one-half the price of unexposed cotton, or at 1932 and 1933 prices about $13 per 500 lb. bale. All the cotton lost strength, but not equally, upon exposure. There was an average loss of 4 per cent. after four weeks and a maximum loss of approximately 14 per cent. for the season. All cottons became darker and less creamy as the exposure increased. In all cases there was a decrease in either creaminess or brightness, or in both, within from three to five weeks after opening. Cotton which opened after frost was stained and much yellower than that opened before frost. Precipitation apparently caused greater darkening than it did loss in creaminess.

Three lots of lint cotton stored in a vault for one year lost respectively 7, 15, and 18 per cent. of their original strength, and after two years of storage, two lots had lost 25 and 33 per cent.

The conclusions reached were that cotton should be harvested, so far as is practicable, not later than four or five weeks and preferably within one or two weeks after opening, to assure a product of high quality in grade, strength, and colour.

103. The Growth in Height and Weight of the Cotton Plant under Field Conditions. By O. V. S. Heath. (Reprinted from *Ann. Bot.*, New Ser., Vol. I., 3, 1937, p. 515.) The growth in height and weight of the cotton plants on the control plots of a field experiment at Barberton, South Africa, in 1933-34 were estimated from random sample plants collected weekly. The data so obtained show that from a height of 10 cm. up to time of flowering the growth of the main axis is approximately exponential. From germination up to a height of 10 cm. the growth does not follow the same exponential course, but shows a higher growth rate due to rapid extension of the hypocotyl. Growth in dry weight, on the other hand, approximates to an exponential curve from germination until flowering. Statistical analysis shows that in the present experiment growth both in height and weight differs slightly but significantly from the exponential course. In the former case the relative growth rate has no definite trend of rise or fall, but fluctuates about a mean value; in the latter it has a slight but significant downward trend. This fall is associated with a fall in the percentage of the total weight for which the green leaves are responsible. Values of $\log_e$ weight and $\log_e$ height are highly correlated, and the relative growth rate in terms of weight is three times as great as that in terms of height.

104. A New Plough for the Laying of Irrigation and Drainage Pipes. (*Monthly Bull. of Agr. Sci. and Pract.*, Int. Inst. of Agr. Rome, August, 1937, p. 314 T.) An ingenious plough designed by Prof. Janert of Leipzig, which moulds the pipe in porous concrete and lays it in the soil. "The porous walls come into immediate contact with the virgin soil so effectively that a direct connection between the capillary pores of the sides of the piping and the capillary surface of the surrounding soil is established. According to this principle the water of the soil passes into the interior of the pipe, and *vice versa*, without any difficulty and evidently involving no obstruction of the drain." Two men are necessary for the working of the machine, which is illustrated and briefly described.

105. Cotton Bale Coverings: Merits of Cotton and Jute. (1) By D. Comer; (2) by J. S. Jenkins. (*Cotton Trade J.*, xvii., 18, Internat. Edn., 1937, p. 118. From *Summ. of Curr. Lit.*, xvii., 17, 1937, p. 494.) It is pointed out that, by the use of cotton bagging in place of jute for cotton bales, a use could be found for

about 1,500,000 bales of low grade cotton, and the suggested imposition by the American Government of a tariff on jute in order to encourage the use of cotton bagging is discussed. The provisions and effects of the Cotton Net Weight Act are also discussed. Arguments for and against the use of cotton bagging are outlined, and the opinions of farmers, merchants, manufacturers and others are quoted.

106. Cotton Bales: Warehousing. By C. A. Bertel. (*Cotton Trade J.*, xvii., **18**, Internat. Edn., 1937, p. 122. From *Summ. of Curr. Lit.*, xvii., **17**, 1937, p. 494.) A general account of improvements in the methods of handling and storing cotton, including improved protection from risk of damage by fire and water, improved methods of sampling and weighing, the general adoption of the single bale receipt, and the use of powerful high density compressing machines.

107. Mechanical Cotton Pickers. By M. G. Barnwell. (*Int. Cott. Bull.*, xv., **60**, 1937, p. 566.) Three mechanical pickers are mentioned: the Rust, International Harvester Co., and the Berry pickers. So far the fact that all the machines pick the cotton " trashy " has not been overcome, and the cotton loses two grades in character, representing a loss of at least $20 a bale. Rust Brothers think they can overcome the problem, and are continuing experiments with a new model.

COTTONSEED AND OIL.

108. Cotton Seed Utilization. By S. M. Harmon. (*Cotton Trade J.*, xvii., **18**, Internat. Edn., 1937, p. 116. From *Summ. of Curr. Lit.*, xvii., **17**, 1937, p. 494.) The average annual production of cottonseed oil in America is 1,500,000,000 lb., and fully 85 per cent. of this is consumed as food—*e.g.*, as shortenings, salad oils, cooking oils and margarine. The average cottonseed contains about 15·5 per cent. of recoverable oil, and close to 5 per cent. is absorbed by cake and hulls, two other important by-products of seed. Oil accounts for an average of 54 per cent. of the value of the products of cottonseed. The average annual production of cottonseed cake and meal in the United States is more than 2,000,000 tons. About 1,250,000 tons of cottonseed hulls are produced each year and used in conjunction with the meal as food for cattle, horses and mules.

109. Gossypol: Absorption Spectrum. By Mlle. R. Grinbaum and L. Marchlewski. (*Bull. Int. Acad. Polon.*, **7**, 1936, p. 367. From *J. Text. Inst.*, xxviii., **9**, 1937, A524.) Pure gossypol, from cottonseed, displays in alcoholic solution well-marked bands with maxima at 3780A and 2390A and a weak maximum at 2910A.

110. Interspecific and Intraspecific Chemical Variation of Cotton Seeds. By M. I. Smirnova. (*Bull. Appl. Bot.*, Ser. III., **15**, Leningrad, 1936. From *Pl. Bre. Absts.*, viii., **1**, 1937, p. 52.) Studies of a number of varieties of cotton showed that in most cases increased oil content of the seeds is accompanied by increased gossypol content. As a preliminary to the identification of forms with a low gossypol content a study of varietal differences in this characteristic was made, and a positive correlation was observed between the number of glands present in histological sections of seeds and the percentage content of gossypol in the different varieties. This finding could, it is suggested, be used as a method of selecting plants with a low gossypol content. The gossypol and oil content of individual plants of a variety differed little; but plants of the same variety grown in different localities exhibited variation in their chemical composition.

As regards species differences, figures are cited showing that varieties of *Gossypium herbaceum* contain the least gossypol, a low oil content, and a high percentage of protein, while forms of *G. barbadense* apparently have a high oil content.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

111. Methods and Equipment for Laboratory Studies of Insecticides. By H. Waters. (*J. Econ. Ent.*, xxx., 1, 1937, p. 179.) A study of methods and equipment for rearing test insects and food plants under controlled and standardized conditions that can be maintained throughout the year. An efficient method for growing certain types of plants in trays under controlled conditions, an automatic method for watering these plants, methods for rearing several species of test insects, and several new types of insect cages, have been developed.

112. Technique of Large-scale Operations in Pest Control. By S. B. Fracker. (*Proc. Ent. Soc. Washington*, xxxix., 3, 1937. From *Rev. App. Ent.*, xxv., Ser. A, 8, 1937, p. 519.) The methods and organization used in the United States in large-scale operations, as distinct from voluntary control measures applied by private growers, are reviewed.

113. Importance of the Study of Insect Ecology in Applied Entomology. By T. Ahmad. (*Ind. J. Agr. Sci.*, vii., 1, 1937, p. 156.) A discussion of the practical importance of studying the effects of environmental factors on insects, illustrated by the author's own work on various species.

114. Seedling Pests of Cotton and their Control. By W. J. S. Sloan. (*Queensland Agr. J.*, June, 1937, p. 538.) A brief description of cutworms, aphids, thrips, jassid, and other seedling pests of cotton in Queensland, and their treatment. A useful cutworm bait is as follows: Paris green, 1 lb.; molasses, 2 quarts; bran, 25 lb.; water, 2-2½ gallons. The Paris green and bran are thoroughly mixed dry, and the water in which the molasses has been dissolved is added to the mixture to make a friable crumbly mash. This bait is scattered around the cotton plants, and is usually successful in combating cutworms and grasshoppers.

115. Report of the Chief of the Bureau of Entomology and Plant Quarantine, 1936. By L. A. Strong. (*U.S. Dpt. of Agr.*, Washington, D.C., 1936. From *Rev. App. Ent.*, xxv. Ser. A, 7, 1937, p. 408.) *Experiments to control cotton pests.* In cage tests of dusts against the cotton boll-weevil *Anthonomus grandis*, Boh., mixtures of calcium arsenate with Paris green at the rates of 3 : 1 and 9 : 1 were more effective than calcium arsenate alone; but in field tests calcium arsenate alone gave better results than these mixtures or than derris with sulphur (1 per cent. rotenone), thiodiphenylamine with sulphur (1 : 9) and calcium arsenate with lime (1 : 1). In a part of South Carolina where infestation was not severe, the three best dusts tested in order of profitable returns in control were: calcium arsenate with lime (1 : 2) employed after the infestation had reached 10 per cent.; calcium arsenate with lime (1 : 1); and calcium arsenate alone. Lime mixtures reduce the danger of soil poisoning and heavy infestation by aphids. Experiments and experience over several years indicate that the germination of the seed and survival of the seedlings of cotton, maize and soy beans are reduced in plots that have received heavy applications of calcium arsenate against the weevil. For the control of the cotton flea-hopper (*Psallus seriatus*, Reut.), dusting with sulphur resulted in an average gain of 167·5 lb. of seed cotton per acre, and a mixture of Paris green and sulphur (1 : 9) resulted in an average gain of 220 lb. A mixture of calcium arsenate

and sulphur (1 : 4) also gave better results than sulphur alone. Cage experiments during the last three years have shown that arsenicals are more effective than sulphur against the adults. *Anaphes anomocerus*, Gir., and a species of *Erythmelus* were found parasiting the eggs of *P. seriatus*. A serious outbreak of the cotton bollworm (*Heliothis armigera*, Hb.) occurred in north-eastern Texas in the summer of 1935; the most satisfactory control was given by calcium arsenate dust, applied at intervals of 4-5 days for as long as the bollworm larvæ were present. In the autumn most of the larvæ died from disease. Recoveries have been made of *Microbracon kirkpatricki*, Wlksn., 122,000 of which were liberated in Texas, Mexico and Porto Rico against the pink bollworm (*Platyedra gossypiella*, Saund.); *Chelonus blackburni*, Cam., was also released in Texas and Porto Rico. *M. mellitor*, Say, from Hawaii, was not reared in sufficient numbers for release, but a winter survival of 89 per cent. was recorded in hibernation tests. The area infested during 1933 was smaller than at any time since the 1926 crop. In Porto Rico, the seedpods of the ornamental trees *Montezuma speciosissima* and *Thespesia populnea*, commonly used for roadside planting, were found to be the most important alternative hosts of the pink bollworm. It was established that resting-stage larvæ occur there. Colonies of *Pimpla* (*Exeristes*) *roborator*, F., as well as of *C. blackburni* and *M. kirkpatricki* were released in Porto Rico and some recoveries were made. At least 15 species of *Rhynchota* attack cotton in Arizona, including *Euschistus impictiventris*, Stal, *Chlorochroa sayi*, Stal, and *Thyanta custator*, F., on the bolls, and *Lygus hesperus*, Knight, and *P. seriatus* on the squares. Cotton is not the preferred food of any of these, and it is only attacked when others are not available. Of bolls with which *C. sayi* and *E. impictiventris* were confined, 30 and 20 per cent. respectively developed boll rot, while tests with *Dysdercus mimulus*, Hussey, have all given negative results. Experimental breeding of *Anthonomus grandis thurberiœ*, Pierce, on cotton exclusively has shown that it is not likely to become a serious pest in Arizona.

Fumigation with hydrocyanic acid gas of warehouses where cottonseed meal is stored in bulk or in sacks gave good control of the cigarette beetle (*Lasioderma serricorne*, F.). When heavy paper bags were used instead of fabric sacks, eggs were laid along the stitching and the larvæ entered the meal, but the exit holes so destructive to fabric bags were not made.

116. Immunity of Certain Insects to Selenium Poisoning. By S. F. and H. M. Trelease. (*Sci.*, **85**, 18/6/37, p. 590.) Certain weevils and seed-chalcids were found to be immune to the selenium contained in one of the most poisonous range plants, *Astragalus bisulcatus*.

117. The Mexican Cotton Boll Weevil, *Anthonomus grandis*, Boh., in Haiti. By A. Audant and A. Occénad. (*J. Agr. Univ. Puerto Rico*, xxi. 1, 1937, p. 69. From *Rev. App. Ent.*, xxv., Ser. A, 7, 1937, p. 440.) *Anthonomus grandis*, Boh., which was formerly confined to the south-eastern United States, the cotton-growing regions of the Pacific and Gulf coasts of Mexico, and a few localities in Central America, was accidentally introduced into Haiti about 1932, and had become a major pest of perennial cotton by 1935. Before its introduction, the annual export of cotton from Jacmal over a period of nine years averaged about 1,400,000 lb., but since 1932 the amount has fallen steadily and was only about 256,000 lb. in 1935-36. A similar decrease in production has resulted in other infested districts. Owing to strict quarantine regulations, infestation has not yet spread to all the cotton-growing districts, though it is impossible to eradicate the weevil or prevent its spreading in the direction of the prevailing winds. Perennial cotton produces fresh green leaves, on which the adult weevils feed, for almost the entire year, and so completely shades the ground between the rows that the immature stages in fallen bolls

and squares are not killed by the heat of the sun. The production of squares is largely confined to two months, but sufficient numbers are produced outside this period to allow the weevil a much longer phase of reproduction than do strains of American Upland cotton specially selected for a short season. The Haitian strains of perennial cotton are, however, very resistant to the pink bollworm (*Platyedra gossypiella*), infestation by which does not normally exceed 1-2 per cent., even at the very end of the picking season. It has been suggested that they should be replaced by an annual short season type, but it is possible that *Anthonomus* may eliminate the strains susceptible to its attack, just as *Platyedra* has eliminated imported varieties.

118. Numbers of Instars of the Pink Bollworm collected in Squares and in Bolls of Cotton. By L. C. Fife. (*Ann. Ent. Soc. Amer.*, **30**, No. 1, p. 57. Columbus, Ohio, 1937. From *Rev. App. Ent.*, xxv. Ser. A, **8**, 1937, p. 515.) Comparison of the frequency distributions of the head widths of 600 larvæ of *Platyedra* (*Pectinophora*) *gossypiella*, Saund., taken from the squares of cotton showed the presence of four instars. There was close agreement between the observed mean head widths of this series of larvæ and of another of 230 taken from bolls, and the values obtained from geometrical progressions computed from the data, which indicates that the head widths of the instars fall in a geometrical progression as stated by Dyar. The growth ratio for the first series was 1·89 and for the other 2·04, but the mean head width of both groups was the same in the first instar.

119. The Theory of Diapause in *Platyedra gossypiella*, Saund. By F. A. Squire. (*Trop. Agr.*, xiv., **10**, 1937, p. 299.) In opposition to many writers, the author considers that the resting stage in the pink bollworm larva has little to do with weather or season, but is in some way connected with the age of the crop. He concludes that "the apparent hibernation or æstivation of the pink bollworm is really a case of diapause, and is induced by dry and/or rich food towards the end of the crop irrespective of the time of the year at which this takes place. The field conditions leading up to this position are (*a*) the increase in the ratio of ripe to green bolls, and (*b*) a sufficiently high incidence of the pest to necessitate the infestation of ripe and ripening bolls. From observations on infested cotton bolls and ochroe pods, it appears that only those larvæ which complete their larval development on ripening seeds are liable to go into the resting stage. The addition of water to the tissues of resting larvæ in most cases expedites emergence, but is not a *sine qua non* thereof, and in a small percentage of cases fails to terminate the diapause."

120. The Effectiveness of Poison Baits against *Chloridea obsoleta*. By N. A. Glushenkov. (In Russian.) (*Plant Prot.* No. 11, p. 137, Leningrad, 1936. From *Rev. App. Ent.*, xxv., Ser. A., **9**, 1937, p. 577.) Experiments with poison baits against larvæ of *Heliothis armigera* Hb. (American bollworm) on cotton were carried out in Southern Uzbekistan. The baits were mixtures of finely ground dry cotton oil-cake with 3-10 per cent. by weight of calcium arsenate, calcium arsenite, or barium fluosilicate. They were applied in the evening at the rate of 36 lb. per acre, chiefly to the plants themselves, as the larvæ seldom descend to the ground. All baits gave good results except those containing barium fluosilicate. The percentage of mortalities of the larvæ on the third and sixth days after treatment were: 58·2 and 83·8 for a bait mixed with 3·3 per cent. of calcium arsenate prepared from scorodite ore and containing 34·9 per cent. As_2O_5; 70·8 and 91·2 per cent. for one with 9·1 per cent. of the same arsenate; 41·2 and 68·8 for one with 3 per cent. of calcium arsenate containing 34·1 per cent. As_2O_5; and 53·6 and 83·6 for one with 10 per cent. of calcium

arsenite containing 66 per cent. As_2O_5. It is recommended that the cotton oil-cake should be ground fine and well sifted so as to cover the plants thoroughly.

121. THE LOCUST OUTBREAK IN AFRICA AND WESTERN ASIA IN 1935. By B. P. Uvarov and W. Milnthorpe. (*Econ. Adv. Coun. Comm. Locust Contr.*, H.M. Sta. Off., 1937. From *Rev. App. Ent.*, xxv., Ser. A., 8, 1937, p. 506.) The breeding and migrations of *Schistocerca gregaria*, Forsk., *Locusta migratoria migratorioides*, R. and F. and *Nomadacris septemfasciata* Serv. are discussed in detail, and illustrated by a series of maps. It is shown how much more international study and action are entering into the campaign against locusts. A bibliography is included of papers dealing with the locust and grasshopper problem.

122. A REPORT ON THE WORK DONE BY THE RESEARCH STAFF UNDER THE LOCUST RESEARCH ENTOMOLOGIST TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH AT KARACHI DURING THE YEAR 1936. By Y. Ramchandra Rao. (From *Rev. App. Ent.*, xxv., Ser. A., 7, 1937, p. 390.) Field studies on *Schistocerca gregaria*, Forsk., phase *solitaria*, were continued in 1936 in British Baluchistan and the Sind-Rajputana desert, and the distribution and breeding of the locust are discussed and correlated with meteorological data. The report concludes with a general survey of the results of locust research in India during the years 1931-36, and includes numerous tables of results of experimental work, as well as some showing the relation between the amount of rainfall and breeding in 1931-36, the meteorological data obtained during ecological work, and statements of expenditure on research.

123. THE MECHANISM OF RESPIRATION OF LOCUSTS AND ITS BEARING ON THE PROBLEM OF INHALATION OF POISON DUSTS. By A. G. Hamilton. (*Bull. Ent. Res.*, xxviii., 1, 1937, p. 53. From *Rev. App. Ent.*, xxv., Ser. A., 7, 1937, p. 457.) The technique used in this study of the effect on locusts of poison dusts acting through the respiratory system, and in determining the size of particles capable of passing through the spiracular openings as well as the wind tunnel, and dusting apparatus used in the experiments, are described.

124. LE CRIQUET MAROCAIN EN ALGÉRIE. By R. Pasquier. (*L'Agr. Rev. Mens. Ass. Anc. Élèves Inst. Agr. Algérie*, Nos. 53-55 repr. Algiers, 1937. From *Rev. App. Ent.*, xxv., Ser. A., 9, 1937, p. 536.) The outbreak centres, the typical vegetation of which consists of *Poa bulbosa*, *Stipa tortilis* and *Bromus* spp., are usually associated with saline soils, abandoned ploughed fields, uncultivated deforested areas, and over-grazed steppe-land. Energetic control by means of poison baits has been carried out against the phases *solitaria* and *congregans*.

125. L'ACTION EXTERNE DES ARSENICAUX SUR LE CRIQUET PELERIN (*Schistocerca gregaria* Forsk.) By P. Lepesme. (*Bull. Soc. Hist. Nat. Afr. N.*, 28, 1, 1937, p. 88.) DE L'ACTION EXTERNE DES ARSENICAUX SUR LES INSECTES. By P. Lepesme. (*C.R. Acad. Sci.*, 204, 9, 1937, p. 717. Both from *Rev. App. Ent.*, xxv., Ser. A., 7, 1937, p. 458.) Adults of *Schistocerca gregaria* Forsk. were dusted with a number of poisons in an apparatus similar to that used by Hamilton, or enclosed in glass tubes, so that only their anterior parts remained free. The results show that sodium arsenite and arsenate, which are the most effective poisons when applied internally, are also the most toxic when applied externally, and that the toxicity of poison dusts increases with the relative humidity of the air. Thus, dusting with sodium arsenite causes the locusts to die in twenty-four hours at 20 per cent. relative humidity, in twelve hours at 60 per cent., and in a shorter time at 100 per cent.

126. THE HUMIDITY REACTIONS OF THE AFRICAN MIGRATORY LOCUST, *Locusta migratoria migratorioides* R. and F., GREGARIOUS PHASE. By J. S. Kennedy. (*J. Exp. Biol.*, xiv., 2, 1937, p. 187. From *Rev. App. Ent.*, xxv., Ser. A., 7, 1937, p. 390.) *Summary*: Under the conditions of the experiments described, *Locusta migratoria migratorioides* shows a preference for dry air in all parts of the humidity range, although dry air is by no means optimal for development, maturation, and breeding. The strength of the reaction is correlated with the magnitude of the humidity difference available, but appears to be little dependent on the region of the humidity range. The mechanism of the reaction is hygrokinetic and possibly hygrophobotactic as well, but probably not hygrotropotactic.

127. THE OCCURRENCE OF THE BROWN AND RED LOCUST IN THE UNION DURING THE SEASONS 1934-35 AND 1935-36. By C. du Plessis. (*Sci. Bull. Dpt. Agr. S. Afr.*, 164, Pretoria, 1937. From *Rev. App. Ent.*, xxv., Ser. A., 7, 1937, p. 456.) During the season 1935-36 locust breeding in the Union was less extensive than in the preceding year, and eggs were laid over an area of 75,000 sq. miles, compared with 300,000 sq. miles in 1934-35. Control measures were successful, so that damage to crops and grazing was negligible.

128. RED SPIDER. By R. Veitch. (*Queensland Agr. J.*, July, 1937, p. 4.) A brief account of the life-history and habits of the pest. Spraying with lime sulphur is recommended, also the eradication of weeds that may act as hosts.

129. THE LIFE-HISTORY OF THE COTTON RED SPIDER IN TASHKENT. By A. A. Tibilova. (In Russian, with English summary.) (From *Data on Pests and Diseases of Cotton Plants*, Tashkent, 1935, p. 168.) The duration of life of the red spider in Tashkent is 19 days in spring, 9 days in summer, and 24 days in autumn. The number of generations in one season is 12. The average number of eggs laid by one female is 140, the maximum number laid by one female being 600. Besides cotton, the pest attacks hollyhock, morning glory, and thorn. It is very resistant to water, and being submerged can live up to 15 days.

130. TEST OF THE DILUTED SULPHUR PREPARATIONS OF THE "ULTRA-SULPHUR" TYPE FOR THE CONTROL OF THE RED SPIDER (*Epitetranychus althææ*). By M. I. Kosubutzkii. (In Russian, with summary in English.) (*Plant Prot.*, No. 9, p. 5, Leningrad, 1936. From *Rev. App. Ent.*, xxv., Ser. A., 7, 1937, p. 391.) The value of different sulphur dusts and a lime-sulphur spray (0·75° Bé) against the red spider on cotton, was tested in field experiments in July, 1935, at Khiva. The amount of pure sulphur in the dusts varied from 13 to 35·8 per cent. They were applied at rates of from 32 to 108 lb. per acre on the second or third day after the plants had been watered, and the spray was used at a rate of 133 gals. to the acre. The results showed that preparations of finely divided sulphur in combination with marl or phosphorite (calcium phosphate), ferro-sulphur (from pyrites slag), and mechanical mixtures of sulphur with lime in proportions varying from 1: 1 to 1: 9 were practically equivalent in effectiveness to pure ground sulphur at the same rate of application (32 lb. per acre.) The radius of action of the particles of sulphur is apparently small, and the effectiveness of the dust depends not only on the quantity applied but also on the evenness of distribution. In the author's experiments the treated colonies of mites were completely eliminated; though the eggs were not affected by the dusts, the young larvæ died as soon as they hatched. The effect of dusting lasted a long time; after 40 days the number of active colonies on the treated plants was only a quarter of that on the control. The lime-sulphur spray, acting by contact, destroyed all stages of the mite, including the eggs, but the solution soon dried

up and ceased to be effective, so that the sprayed plants became reinfested. From the calculations of the gradual increase of the leaf surface of cotton plants during the season, the author suggests that the quantity of dust required per acre would rise from 32-40 lb. in May-June to 90 lb. in August-September.

131. SOUTH CAROLINA : PLANT DISEASE WORK, 1936. (*S. Car. Sta. Rpt.*, 1936. From *Exp. Sta. Rec.*, 77, 1, 1937, p. 54.) Progress reports are given relative to studies on cotton wilt and cotton seedling diseases (including the germination of seed with reference to locality of origin, seed treatments, and varietal resistance to anthracnose).

132. STIMULATED ACTIVITY OF NATURAL ENEMIES OF NEMATODES. By M. B. Linford. (*Science*, **85**, 29/1/37, p. 123.) Decomposition of fresh organic matter in the soil seems to stimulate the activity of the nematode-destroying fungi in Hawaii.

133. ANNOTATED HOST LIST OF UGANDA PARASITIC FUNGI AND PLANT DISEASES. Pt. III. By C. G. Hansford. (*E. Afr. Agr. Jour.*, iii., **1**, 1937, p. 79.) A continuation of previous lists.

[*Cf.* Abstr. **692**, Vol. XIV. of this Review.]

134. A NEW BRAZILIAN CHALCIDOID PARASITE OF *Gasterocercodes gossypii*, PIERCE (HYMENOPTERA). By A. B. Gahan. (*Rev. Ent.*, vii., **1**, Rio de Janeiro, 1937. From *Rev. App. Ent.*, xxv., Ser. A., **8**, 1937, p. 510.) Descriptions are given of the characters of the Pteromalid genus *Eurydinoteloides*, Girault, and also of both sexes of *E. longiventris*, sp. n., a primary external parasite of *Gasterocercodes gossypii*, Pierce, in São Paulo.

135. THREE NEW BRAZILIAN SPECIES OF *Heterospilus* (*Hym. braconidæ*). PARASITES OF *Gasterocercodes gossypii*, PIERCE. By C. F. W. Muesebeck. (*Rev. Ent.*, vii., **1**, Rio de Janeiro, 1937. From *Rev. App. Ent.*, xxv., Ser. A., **8**, 1937, p. 509.) Descriptions are given of both sexes of *Heterospilus gossypii*, sp. n., and *H. hambletoni*, sp. n., and the female of *H. annulicornis*, sp. n., all reared from *Gasterocercodes gossypii*, Pierce, in São Paulo. This weevil is a serious pest of cotton in Brazil.

136. O CARIMA OU ANTHRACNOSE DAS MACAS DE ALGODOEIRO. By A. A. Bitancourt. (*Biologico*, iii., **3**, 1937, p. 101. From *Rev. App. Mycol.*, xvi., **9**, 1937, p. 606.) Anthracnose of cotton bolls is stated to be very prevalent in the cotton plantations of São Paulo, where it is commonly attributed to the agency of a fungus (? *Glomerella gossypii*); the etiology of the disease, however, is complicated by the fact that very frequently the typical anthracnose spots, dark wine-red and depressed, are mixed with bacterial spots which, in early stages of development, only differ from the healthy tissue in their oily appearance and slightly darker colour. Often, too, the bacterial spots may develop in very young bolls, free from typical anthracnose lesions, leaving open the question of which of the two organisms is the primary pathogen. In the West Indies the bacterium (*Bacterium malvacearum*) is held to be the responsible agency, and this view is supported by S. C. Harland, who bases his opinion on the fact that some new cotton varieties recently introduced by him into São Paulo exhibit a high degree of resistance to the bacterium, and have so far remained immune from anthracnose lesions.

137. "SPORE MATS" OF *Phymatotrichum omnivorum*. By J. T. Presley and C. Thom. (*Phytopathology*, xxvii., **4**, 1937, p. 588. From *Rev. App. Mycol.*, xvi., **9**, 1937, p. 606.) Better "spore mats" of the cotton root rot fungus (*Phymatotrichum omnivorum*) for investigation in the field at Sacaton, Arizona, were found to be obtainable by protecting them from the sun, wind, and insects. The white, cheesy masses of mycelia were carefully covered as they began to

develop, and within a week the supporting cells had broken down and the mat was largely composed of a powdery spore mass enveloped by a loose hyphal membrane and bearing a general resemblance to the closed fruit body of a Gasteromycete or to some obscure accessory structure of an Ascomycete, rather than to the fruit mass of a Hyphomycete.

138. A Method for the Control of Cotton Root Rot in the Irrigated South-west. By C. J. King. (*U.S. Dept. Agr. Circ.* 425, 1937. From *Exp. Sta. Rec.*, 77, 1, 1937, p. 58.) The method successfully used in Arizona " consists in burying liberal quantities of organic manures in deep furrows in infested areas during the winter, irrigating to encourage rotting, and planting cotton over the decaying material in the spring. The control is more efficacious with successive treatments and should be continued over a period of years in order to build up and maintain an abundant microfloral population in the soil. The root rot fungus (*Phymatotrichum omnivorum*) does not thrive in the presence of great activity on the part of saprophytic organisms, and the cotton plants frequently escape infection. The method should be applicable to row crops in any part of the irrigated region where root rot exists."

139. Studies on the Root-Rot Disease of Cotton in the Punjab. IV. The Effect of Certain Factors Influencing Incidence of the Disease. By R. S. Vasudeva. (*Ind. J. Agr. Sci.*, vii., 4, 1937, p. 575.) *Summary.* The bearing of soil moisture on the incidence of the root-rot disease of cotton is indicated. *Rhizoctonia solani* and *R. bataticola* cause heavy infection at 15 per cent. and 20 per cent. soil moisture. Evidence of periodicity in parasitic activity of the causal fungi has been correlated with the time of sowing, showing thereby that the virulent attack of the disease may be evaded by skipping over the period of optimum activity of the causal organisms. There is no significant difference in the incidence of the disease when cotton is sown on " ridges " or " flat."

[*Cf.* Abstrs. **307**, Vol. XIII., **127**, **711**, Vol. XIV. of this Review.]

140. Anatomical Study of Wilt of Cotton at Various Times of Infection. By V. Yablokova. (In Russian, with English summary.) (*Plant Protection No.* 13, Lenin Acad. of Agr. Sci., Inst. for Plant Prot., 1937.) In wilt caused by *Verticillium dahliæ* infection appears possible at any period. Details are given of the manner in which the infection spreads, and it is considered that early infection is less injurious. The destruction of all plant debris is suggested as a measure of control.

141. Relatorio Sobre a Murcha do Algodoeiro, Causada Pelo *Fusarium vasinfectum* Atk. no Estado da Parahyba. By H. V. S. Grillo. (*Rodriguesia*, ii., 7, 1937, p. 319. From *Rev. App. Mycol.*, xvi., 9, 1937, p. 607.) The author states that cotton wilt (*Fusarium vasinfectum*) is definitely established in the state of Parahyba. The areas are few and limited, and recommendations are made with a view to preventing further spread, such as the total destruction of all infected cotton plants and other hosts, quarantine restrictions of exports from the state, and the planting of resistant strains of cotton.

GENERAL BOTANY, BREEDING, ETC.

142. The Art and Science of Plant Breeding. By G. D. H. Bell. (*Agr. Progr.*, **14**, 1937, p. 126. From *Pl. Bre. Absts.*, viii., 1, 1937, p. 1.) The author reviews the relation of cytology and genetics to plant breeding, and shows that they have some influence on the methods used by the plant breeder. He concludes, however, that plant breeding, depending for its success on the judgment, experience and skill of the breeder, is still largely an art.

143. STUDIES IN PLANT-BREEDING TECHNIQUE. II. THE DESIGN OF FIELD TESTS OF PLANT-BREEDING MATERIAL. By J. B. Hutchinson and V. G. Panse. (*Ind. J. Agr. Sci.*, vii., **4**, 1937, p. 531.) The use of replication and randomization in progeny row breeding work is described and illustrated from experiments on a range of agricultural crops. The standard randomized block technique was adapted to progeny row work by reducing the plot size to a single row 5 ft. or 10 ft. long according to the amount of seed available. Fluctuations in stand are inevitably large in such trials, and their effect on the estimation of yield is eliminated by the use of the analysis of co-variance. Examples are given of the standard errors obtained in work with a number of crops of different habits and seasons of growth, and it is shown that with ten replications, standard errors of 10 per cent. of the mean, or less, may be expected for yield, and for characters such as staple-length and ginning percentage in cotton they may be as low as 2 or 3 per cent. For testing groups of progenies belonging to related families, the compact family block design is described involving a further restriction on the randomization. By this method a more accurate comparison is possible between progenies of the same family, while the loss in replication for family comparisons is fairly well compensated by the increase in the size of the family plots. It is shown that the compact family block design can be used to provide a comparison between families of the average genetic variance within their progenies. The importance of this comparison for the guidance of the plant breeder in making further selections is emphasized. Examples are given illustrating methods of reducing the labour of computation by ignoring comparisons which are unlikely to provide information of value. Methods suggested by Yates for overcoming the difficulties of very unequal amounts of seed from different parent plants are illustrated by practical examples, and the "missing plot technique" is modified for use with one of them. The use of small bulk trials to supplement progeny row trials in breeding work is illustrated, and their value for retaining a wider range of types than can be maintained in progeny rows is demonstrated. Current methods and recent refinements in progeny row breeding are discussed and compared with the replicated progeny row technique. It is concluded that the latter is more efficient, more flexible, and of much wider application, than any other method. In addition to providing estimates of mean values and tests of their significance for all measurable characters, it provides a basis for the comparison of genetic variances which has given valuable information and is capable of wide extension.

[*Cf.* Abstr. **138**, Vol. XIV. of this Review.]

144. AN OUTLINE OF CYTOLOGICAL TECHNIQUE FOR PLANT BREEDERS. Imperial Bureau of Plant Genetics. (Price 1s. 6d. From *Agr. J. Br. Guiana*, viii., **2**, 1937, p. 109.) Sir Daniel Hall remarks in a brief foreword to this bulletin that a knowledge of cytology and some acquaintance with its technique has become essential to the plant breeder. The aim of the publication is to give an account of the standard methods used in plant cytology, and it is based on practical experience with these methods rather than on a survey of the literature. A description is given of the paraffin method, including staining with iron alum-hæmatoxylin and with gentian violet, the acetocarmine technique (a method particularly useful for plant breeders), and smears with standard fixatives and stains. Hints are given on the use of the microscope, and the bulletin concludes with a list of fixatives with formulæ, and a short bibliography.

145. THE PROMISE OF MODERN BOTANY FOR MAN'S WELFARE THROUGH PLANT PROTECTION. By E. C. Stakman. (*Sci. Monthly*, xliv., 1937. From *Trop. Agr.*, lxxxix., **2**, Ceylon, 1937, p. 98.) A discussion of such matters as protection against pests and diseases, crop adaptation to local ecology, the interchange of

disease or pest carriers between plants, quarantine, eradication campaigns, breeding of improved yielding and of resistant varieties, etc.

146. Inheritance of the Form of the Leaf in Cotton. By E. Vellasco. (In Portuguese.) (*Rodriguesia*, 2, Rio de Janeiro, 1936, p. 197. From *Pl. Bre. Absts.*, viii., 1, 1937, p. 52.) A plant from the fifth selfed generation of the variety Webber Deltatype with normal leaves was crossed with a form having extremely short leaves with 3-5 very narrow lobes; this plant was found in a field of the same variety and may be either a mutant or segregate from a natural cross with okra; in leaf type it is almost identical with *G. Schottii*. The F_1 was intermediate in both reciprocal crosses. It was selfed and back-crossed and the results conformed with a Mendelian interpretation in the presence of one pair of factors.

147. Variations in the Leaves of Cotton Plants Grown under Irrigation in the Sudan Gezira. By G. B. Portsmouth. (Reprinted from *Ann. of Bot.*, New Series, Vol. I., No. 2, 1937, p. 277.) Plants of X1530, a type of Sakellaridis cotton, were grown under irrigation during the two seasons 1934-35 and 1935-36, and the results of observations on area, dry weight, water content, and nitrogen content of the leaves are reported. All leaf samples were grouped according to the nodal positions of the different leaves, so that changes with time in the successive individual leaves could be determined.

Attention is first drawn to the very different shapes and sizes attained by the successive leaves as an indication that there may be also similar differences in their more fundamental characteristics. This is actually found to be the case in respect of all those features examined. Not only do no two successive leaves commence their life history with the same constitution, but the course of the subsequent changes taking place as they age may be also dissimilar. As pointed out by Richards (1934) two distinct age drifts are dealt with here: that of the individual leaf and that of the shoot as a whole. Attempts to deduce the age sequence of a single leaf from the particular values observed in successive members at any one time are therefore invalid.

The value of the dry weight per 100 sq. cm. (leaf thickness) was found to continually increase with time in any one leaf, while the initial value of this ratio also became greater as successive leaves were produced by the shoot. Evidence is brought in support of the contention that the effect observed was, to some extent, the result of climatic changes.

Marked differences were found in what has been termed the basic water content of the leaf. Here the initial water content, expressed on a dry weight basis, fell rapidly from leaf to leaf up to about the fifteenth node, after which it became very nearly constant. The water content of any one leaf was also found to fall rapidly as it aged.

Relations similar to the above were found to hold for percentage nitrogen. There was, however, a slight rise in the initial nitrogen levels of the leaves produced during the second growing period. This was to be expected, since it has been shown by Crowther (1934) to be a consequence of the resumption of nitrogen uptake by the roots after maturation of the first crop of bolls has been completed.

The total nitrogen in any particular leaf, as contrasted with the percentage nitrogen, rose rapidly to a maximum, which corresponded to the time at which the expansion of the lamina was completed, and then continued to fail slowly in conformity with the percentage content.

The extent of the diurnal fluctuations in leaf water content is indicated, while data illustrating the marked effect of irrigation on basic water content are also presented.

148. Variation in the Leaf Form in the Cottons Moco and Rim de Boi. By E. Vellasco. (In Portuguese.) (*Rodriguesia*, 2, Rio de Janeiro, 1936, p. 275.

From *Pl. Bre. Absts.*, viii., 1, 1937, p. 54.) Observations were made on the leaf form of the variety Rim de Boi (*Gossypium brasiliense*) and Moco (*G. vitifolium*), using the two formulæ of Hutchinson $\frac{A}{B}$ and $\frac{A}{E}$. In Rim de Boi the correlation between these two values was much lower than that observed by Hutchinson in Egyptian cottons, and did not amount to more than +0·19. The results of the measurements of 105 leaves of one variety and 110 of the other are given in the form of frequency distributions and graphs, the value $\frac{A-B}{E}$ (Leake's formula) being given for comparison. The variation of this value was higher than that of the other two. The variation in all was high, however, and in most cases trimodal, indicating the heterozygosity of the populations examined.

149. A Genetical Study of Roots in Relation to Disease-Resistance in Cotton. By V. G. Panse and A. F. Patel. (*Ind. J. Agr. Sci.*, vii., 3, 1937, p. 451.) *Summary :* A rapid method of exposing and examining roots of cotton plants is described. A long tap-root, a large number of laterals in the lower regions and a small number of laterals in the upper region are shown to be associated with greater resistance of certain varieties to root-rot. Similar differences are shown to exist between resistant and unselected plants within Broach 9. Such differences within a strain justify single-plant selection based on desirable root characters.

150. The Use of *Gossypium herbaceum* L. in Practical Breeding Work. By N. N. Konstantinov. (*Sojuznikhi*, Tashkent, 1936. From *Pl. Bre. Absts.*, viii., 1, 1937, p. 55.) Recent extensive studies of the species *G. herbaceum* have revealed the existence in it of a number of extremely valuable types for breeding. Among those mentioned are forms from western China (Turfan region) earlier than any other known cottons, reaching maturity in 90-95 days, which is 15-20 days before the earliest Upland types. Early cottons were also found in various countries in Asia Minor. The form from Turfan (var. Kuldjanum of Zaitzev), in spite of its great earliness, is yet slow in the period from bud formation to flowering, and it is believed that by crossing it with varieties that are rapid in this period still earlier forms would be attained. Some of the forms collected in Afghanistan, Iran and Central Asia have quite large bolls weighing up to 5·5 gm. Others had lint up to 32 mm. in length, and some had ginning percentages up to 37 per cent., but these latter types unfortunately had the disadvantage of being late in maturing. Special interest is attached to the forms with non-dehiscent bolls for breeding cottons resistant to wind damage and suitable for mechanical harvesting, since no loss accrues if the bolls are left on the plants until all are ripe. Most of the forms are more drought-resistant than the American and Egyptian cottons, some being quite exceptionally tolerant of unfavourable conditions. These various desirable characters occur separately in different individuals, but could no doubt be combined by hybridization, whereby unexpectedly valuable forms of this species might be produced, especially in connection with new or unfavourable cotton areas. Some of the forms might also be used with advantage in interspecific crosses.

151. The Application of Ringing and Wiring to Interspecific Crosses of the Genus *Gossypium*. By M. Tanaka. (*Mems. of Coll. of Agr., Kyoto Imp. Univ., Japan*, No. 39, 1937.) *Summary :* This paper deals with the influence of the application of ringing or wiring to the flowering branch of the pistillate parent upon the production of hybrid seed. The crosses were made between *Gossypium herbaceum* ($2n=26$) and *G. hirsutum* ($2n=52$). By the application of ringing or wiring better results, in comparison with the control, were obtained. The

best results were obtained by ringing, in which 56·41 per cent. (probably 61·8 per cent. if not injured by wind) in contrast with 35·5 per cent. of the control in crosses *G. herbaceum* (♀) × *G. hirsutum* (♂), and 15·0 per cent. (probably 37·9 per cent.) in contrast with 2·1 per cent. of the control in the reciprocal crosses, were obtained. If *G. herbaceum* was used as female and *G. hirsutum* as male, only empty seeds were obtained. In the reciprocal crosses, however, some viable seeds were obtained.

152. Three Genes in a Wild Species of Cotton (*G. armourianum* Kear.). By S. C. Harland. (*Trop. Agr.*, xiv., 5, 1937, p. 156.) A plant of the American diploid species *Gossypium armourianum* Kearney was crossed with a type of *G. barbadense* with three recessive characters—viz., cream corolla, cream pollen, and no petal spot. The *armourianum* parent had yellow corolla, yellow pollen, and strong petal spot. In the F_1 1 : 1 segregation was observed for each of these characters, showing that the *armourianum* parent must have been heterozygous in respect of each of them. The three characters were inherited independently. The *armourianum* genes may be denoted as Y^{AR} (yellow corolla), P^{AR} (yellow pollen), and S^{AR} (petal spot).

153. Perennial Cottons and their Importance in Breeding Work. By N. N. Konstantinov. (*Sojuznikhi*, Tashkent, 1936. From *Pl. Bre. Absts.*, viii., 1, 1937, p. 53.) Perennial cottons, where grown under curtailed illumination, display an unexpected range of variation in type. Types of *G. peruvianum*, possessed of unusually large bolls, are considered useful for hybridization. Some of these types have very long lint (up to 40 mm.), and are being crossed with Egyptian cottons to increase the boll size of the latter. Many of the perennial forms are highly disease resistant, and one species at least, *G. lancœforme* Miers, is frost resistant.

154. Pigmentation in the Root of the Cotton Plant. By H. V. Jordan *et al.* (*Soil Fert. Div. U.S. Dpt. Agr.* From *Sci.*, 86, 16/7/37, Suppt., p. 60.) There has been observed a general correlation of the pigmentation of the cotton root with the physiological age of the plant, the reaction of the soil, the effect of fertilizers, and the incidence of cotton root rot as observed in the field.

155. The Pistil Anatomy of Cotton as related to Experimental Control of Fertilization under Varied Conditions of Pollination. By C. C. Doak. (*Amer. J. Bot.*, 24, 1937, p. 187. From *Pl. Bre. Absts.*, viii., 1, 1937, p. 54.) The ontogeny and structure of the pistil of cotton are described. There is a tendency for pollen grains placed on a given lobe of the stigma to fertilize ovules in the corresponding locule, which can be marked at the time of pollination. It is therefore feasible to use certain locules simply to produce sufficient non-hybrid seed to ensure setting of the boll, while other locules are used for obtaining distant crosses or parthenogenetic embryos. As pollen tubes can cross over to a different locule it is necessary to have a method of distinguishing the normal seeds produced in the experimental locule. This can be done if the female parent is homozygous for *r* (green leaves), and the pollen used for producing the normal seed carried *R* (red leaves).

156. Chlorophyll Deficiency and Modifying Factors in New World Cotton. By S. C. Harland. (*Z. indukt. Abstamm. -u. Vererb Lehre*, 73 1937, p. 49. From *Pl. Bre. Absts.*, viii., 1, 1937, p. 52.) Chlorophyll deficient c^{ha} C^{hb}, occurring in the F_2 of crosses between *Gossypium barbadense* of the constitution C^{ha} c^{hb} and *G. hirsutum* of the constitution c^{ha} C^{hb}, was transferred by back-crossing to *G. hirsutum* and *G. barbadense*. In *barbadense*, the expression of the character was very severe, and for the most part chlorophyll deficient seeds were non-germinable and lighter than normal seeds, sometimes with minute embryos.

In the *hirsutum* genotype chlorophyll deficiency was manifested as a pale yellow form, lethal in the seedling stage. The genotype c^{ha} c^{hb} is therefore lethal and non-germinable in *barbadense*, but lethal and germinable in *hirsutum*. Owing to segregation of the different systems of modifiers of the two species, viable chlorophyll deficient types can be obtained in the F_2 of *barbadense* × *hirsutum*. Such types have yellowish green cotyledons and normal green leaves in the adult stage. The rate of progress of disadvantageous mutants towards normality as envisaged by Fisher is therefore enormously accelerated in inter-specific crosses.

157. Sterility in Cotton. By L. S. S. Kumar. (*J. Univ. Bombay*, v., **5**, 1937. From *Pl. Bre. Absts.*, viii., **1**, 1937, p. 10.) Six or seven completely sterile plants occurring spontaneously in the cotton variety 1027 A.L.F. (*Gossypium herbaceum*) were studied cytologically. The pollen grains were very varied in size and only about 20 per cent. had protoplasmic contents. The plants produced a high proportion of abnormal tetrads; they were completely sterile on both male and female sides. Meiosis in the pollen mother cells was apparently regular until diakinesis. Here univalents and multivalents appeared as well as bivalents and more than the normal 26 chromosomes were present in some cells. Lagging of chromosomes was very common at both anaphases and at second metaphase more than two spindles were often present. The origin of the plants is ascribed to a mutation affecting one boll on a single plant in the preceding generation. Although the plants normally do not set a single boll, when propagated by grafting one single boll with a few seeds was obtained by open pollination. The single plant obtained from these seeds differs from the parent in many morphological characters and is highly fertile.

158. Outlines and Prospects of Cotton Breeding in Central Asia. By A. M. Maltsev *et al.* (*Sovetskii Khlopok*, **1**, 1937, p. 47. From *Pl. Bre. Absts.*, viii., **1**, 1937, p. 51.) The great improvement in output of the new varieties such as "8517," that combine increased yield with greater ginning outturn and lint length, is emphasized. The new strains also contain 1-2 per cent. more oil in the seeds. Two new mid-season cottons have a lint length of 32-33 mm., ginning outturn of 38-39 per cent., large bolls, compact habit of growth, and a good yield. A series of American cottons with thin, silky lint 38-41 mm. in length has been produced; they have a ginning outturn of 32 per cent. and exceed Navrotskii in yield. Among the Egyptian cottons the strain No. 35-1 is 10-15 days earlier than Maarad, which it exceeds by 15-30 per cent. in lint yield; it has a staple of 36-38 mm. and ginning outturn of 33-35 per cent., the lint being unusually strong. Other promising early Egyptian varieties are also described, all being less susceptible to gummosis than Pima and Maarad, and more resistant to cold. Several wilt-resistant strains have been isolated, one of the best being a selection from Hallmark with lint length of 37-40 mm.

159. Outlines and Prospects of Breeding Work with American Cotton in Transcaucasia. By I. Varuntsjan. (*Sovetskii Khlopok*, **1**, 1937, p. 55. From *Pl. Bre. Absts.*, viii., **1**, 1937, p. 51.) The new varieties produced by the Azerbaijan cotton station have entirely replaced the earlier grown varieties. Of these No. 915, produced by selection from the local strain King Karajazskii, is early, cold-resistant, highly wilt-resistant, with a very large boll and lint 28-29 mm.; its defect is insufficient drought resistance. Another strain, No. 01064, a segregate from a natural hybrid of King Karajazskii, exceeds the local standard by 20 per cent. in yield and by 2 mm. in lint length, has extremely large bolls, and has great wilt resistance.

160. Résumé of Results and Objects of the Research Work of the Central Breeding Station, Sojuznikhi. (*Tashkent*, 1936. From *Pl. Bre.*

Absts., viii., 1, 1937, p. 48.) The work contains the following articles of interest to plant breeders: "Breeding American Varieties of Cotton" (S. S. Kanas); "Breeding Egyptian Cotton" (A. I. Avtonomov); "Testing New American and Egyptian Cotton Selections with the Object of Devising a Plan for their more Rational Utilization in Cotton-growing Districts"; "Testing the Degree of Cross-pollination in Cotton" (J. D. Nagibin); "On the Question of Ginning Outturn in Cotton"; "Inheritance of Boll Size in American Cotton, *G. hirsutum* Linn."; "Inheritance of Seed Pubescence in Cotton, *G. hirsutum* Linn."; "Inheritance of Morphological Characters" (V. I. Kokuev); "Interspecific Hybridization between Cotton Species differing in Chromosome Number" (S. S. Kanas); "Interspecific Hybridization in Cotton"; "Work on Experimental Production of Mutants in Cotton" (K. A. Vysotskii); "Investigation of the 'Wild' Species of *Gossypium*" (N. N. Konstantinov); "The Morphology of Cotton Chromosomes" (K. A. Mikhailova); "Chromosomes of Cotton Hybrids and their Behaviour in the Reduction Division" (P. A. Baranov and M. S. Kanas); "The Reasons for the Difficulty in Crossing Distant Species of Cotton" (I. D. Romanov); "Germination of Cotton in Salt Solutions of Different Concentrations" (V. A. Novikov).

161. THE QUESTION OF THE TECHNOLOGICAL QUALITIES OF THE RAW COTTON FROM F_1 INTERSPECIFIC HYBRIDS BETWEEN AMERICAN AND EGYPTIAN COTTON. By O. V. Sokurova-Vysotskaja. (*Sojuznikhi*, Tashkent, 1936. From *Pl. Bre. Absts.*, viii., 1, 1937, p. 54.) The F_1 hybrids between *G. hirsutum* and *G. barbadense* display marked heterosis vegetatively, and produce unusually large numbers of seeds, which are larger than those of either parent. Studies of the lint characters of a number of hybrids showed them to be above the parents also in lint length, which was on the average 2-5 mm. longer than in the Egyptian parent, and also 10-13 mm. above the Upland parent, one of the hybrids having a lint length of 40·3 mm., while none of the parents had lint longer than 35 mm. The lint was more uniform than that of the Egyptian parent and gave much less waste than that of the Upland parent, having a high proportion of long-staple fibres like Egyptian. The lint was of a fineness and a strength equal to the Egyptian, and the metric number was slightly higher. In ginning outturn the hybrids were equal to the Egyptian parent but inferior to the Upland; the number of unripe seeds was, however, great, being more than in both parents, and the fuzz was equal to that of the Upland parent. Comparison with standard varieties of American and Egyptian cottons showed some of the hybrids to be superior even to Sakellaridis. Very satisfactory spinning tests were also obtained with the hybrids and attempts are being made to propagate them vegetatively.

162. ON THE QUESTION OF INCREASING THE WEIGHT OF LINT PER BOLL IN EGYPTIAN COTTON. By N. Avtonomova. (*Sojuznikhi*, Tashkent, 1936. From *Pl. Bre. Absts.*, viii., 1, 1937, p. 53.) Gives the results of experiments to increase the boll size of Egyptian cotton by crossing a number of varieties of *G. barbadense* with various large-bolled forms of *G. peruvianum*.

163. A NEW CHROMOSOME MODEL. By H. B. Newcombe and G. B. Wilson. (*J. of Herad.*, xxviii., 4, 1937.) A description, with illustrations, of a useful model made with four equal lengths of rubber tubing painted different colours, joined by glass tubes. The model has already been used in testing out current theories of crossing-over and chiasma formation, and has been found very satisfactory.

FIBRES, YARN, SPINNING, WEAVING, ETC.

164. INDUSTRIAL FIBRES. (Printed and pubd. for the Imp. Econ. Committee by H.M. Stat. Off., 1937. Price 2s. 6d. net., 2s. 9d. post free.) A useful summary of figures of production, trade, and consumption relating to cotton, wool, silk,

flax, jute, hemp, and rayon, compiled in the Intelligence Branch of the Imperial Economic Committee. In connection with cotton, figures are given for acreage, unit yield, production, varieties, exports, imports, mill consumption, production of cotton yarns, stocks, prices.

In 1936, over 15,000 million lb. of ginned cotton was produced on 86½ million acres, compared with about 12,700 million lb. from 79 million acres in 1935. It appears likely that world production in 1937 will show a further increase in view of the large crop expected in the United States.

165. Fibres: Length Measurement. By J. Desprez. (*L'Indus. Text.*, **54**, 1937, p. 274. From *Summ. of Curr. Lit.*, xvii., **18**, 1937, p. 545.) Various methods and apparatus for the measurement of the length of fibres, including those of Cobb, Sever, Balls, Baer, Chandler, Kühn-Meyer, Deltour, Ahmad and Nanjundayya, are briefly described.

166. Cotton Fibre: Effect of Processing on Strength. By F. Ahmad. (*Indian Text. Jour.*, **47**, 1937, p. 364. From *Summ. of Curr. Lit.*, xvii., **19**, 1937, p. 583.) A general account is given of the effects of processing on cotton quality, recent investigations by Braschler, Underwood, Navkal and Turner, and Colin being cited, and especially work at Reutlingen on blowroom processes.

167. Cotton Hair: Structure. By W. K. Farr. (*J. App. Physics*, **8**, 1937, p. 228. From *Summ. of Curr. Lit.*, xvii., **15**, 1937, p. 438.) A general account is given of the experimental evidence which has led the author to the conclusion that, in the cotton hair cellulose particles are present in the cytoplasm at the earliest stage of elongation, and that the formation of the cell membrane from these particles begins soon afterwards, the membrane consisting of rows and rows of these particles closely pressed together until their identity is lost in the formation of the cellulose fibrils. The cellulose particles are coated with a hard, pectic, cementing material, and the fibrils are fastened upon the original limiting membranes of the hair by means of this material. By treatment with suitable reagents the cementing material can be swollen and finally destroyed, and the cellulosic content of the particle liberated.

168. Textile Fibres: Structure and Methods of Investigation. By E. R. Schwarz. (*Text. Res.*, **7**, 1937, pp. 271 and 310. From *Summ. of Curr. Lit.*, xvii., **17**, 1937, p. 510.) A general account written in popular style of modern views on the structure of textile fibres, and of the means by which the data forming the basis of these views have been obtained. The importance of the textile technologist as the interpreter of scientific results to the manufacturers is emphasized.

169. Textiles: Moisture Content and Electrical Properties. By A. C. Walker. (*J. App. Physics*, **8**, 1937, p. 261. From *Summ. of Curr. Lit.*, xvii., **15**, 1937, p. 439.) A general account is given of the critical dependence of the electrical properties of textiles on moisture content and relative humidity, the electrical properties of cotton, and the distribution of moisture in cotton. A theory of moisture adsorption is outlined that enables very loose estimates to be made of cotton moisture content from swelling data, and conversely. The mechanism of shrinkage in wool and cotton is briefly explained, and classified under fibre shrinkage, yarn shrinkage, and increase of crimp.

170. A Photometer for the Measurement of the Lustre or Gloss of Textile and Other Materials. Part I. Construction of Instrument. By D. A. Derrett-Smith. (*J. Text.* Inst., xxviii., **9**, 1937, T293.) A compact and portable instrument is described for the evaluation of the lustre of textile and other materials by comparing the brightness of the surface under examination with that of a standard white surface (barium sulphate) under the same conditions

of illumination. Provision is made whereby observations may be made at a number of angles for a given angle of incidence of the illuminating beams. In addition, the angle of incidence of the latter may also be varied. Measurements may be carried out by placing the instrument on the test surface without the necessity of cutting a sample from the latter.

171. SERVICEABILITY OF FABRICS. By C. M. Whittaker. (*J. Text. Inst.*, xxviii., 7, 1937, P173.) A discussion of the recent economic conditions which have seen a gradual deterioration in the wearing qualities of British textiles, mainly due to the evil effects of using cheap and unsuitable dyes. On the other hand, several new processes were introduced during the years of depression which are acknowledged as definite improvements in the wearability of fabrics—*e.g.*, the Tootal anticrease treatment, Trubenizing and Sanforizing.

172. THE SERVICEABILITY OF FABRICS IN REGARD TO WEAR. TESTING FABRICS TO FORETELL SERVICEABILITY. By F. T. Peirce. (*J. Text. Inst.*, xxviii., 7, 1937, P181.) From the summary we quote the following: Tests should be devised to measure characters, defined by behaviour under the simplest possible conditions. In the present state of the theory of cloth structure it is not possible to bridge the gap between simple tests of structure and behaviour in service; hence arises the necessity for complex tests. If statistical surveys of service are impracticable, observation of consumer use may be supplemented by simplified service trials reproducing the actual conditions of service. Strength is a character so complex and so important that direct tests are necessary. The tensile test is insufficient, as tension itself contributes to the cohesion. Disruption is not the only ground for unserviceability. Loss of other qualities may end the useful life of a garment. Test results are not direct measures of serviceability. They must be interpreted statistically by trained judgment resting on the twin bases of theory and experience. Statistical considerations almost preclude the fine ranking of actual samples for serviceability; testing finds an easier and very fertile field in the correction of weak features in cloth structure and make-up of garments.

173. COTTON YARN: MERCERIZATION. By A. J. Hall. (*Text. Merc. and Argus*, 96, 1937, p. 573. From *J. Text. Inst.*, xxviii., 8, 1937, A438.) A summary is given of recent work leading to an understanding of the process of mercerization.

174. COTTON YARNS: STRENGTH AND IRREGULARITY. By H. Dietz. (*Textil-berichte*, 18, 1937. From *Summ. of Curr. Lit.*, xvii., 17, 1937, p. 510.) A general review of the factors involved in the measurement of the strength of yarns.

175. YARN STRENGTH OF EGYPTIAN MIXINGS. By F. Dunkerley. (*J. Text. Inst.*, xxviii., 8, 1937, T255.) The yarn strength of a 50 : 50 mixing of any two Egyptian cottons is near to the average yarn strength of the components spun unmixed. Cottons contribute their undiminished quota to the yarn strength of mixings proportional to the quantities present, however many components there may be to the mixing and whatever the proportions mixed. Even the asymmetrical structure produced by spinning a double roving yarn from odd roving bobbins is equal in strength to the mean of the components. Attention is drawn to the tendency of mixings to be slightly higher in strength than the average of components; it is concluded that irregularity of staple (as distinct from wastiness) is not in itself a cause of weak yarn.

176. UNDYED YARNS. (*Science*, 85, No. 2,199, February 19, 1937, p. 10.) New methods of examining undyed yarns, developed by Prof. E. R. Schwarz of the Massachusetts Institute of Technology, show the history of the yarn and even its age when picked. Polarized light and the microscope are the tools of the new technique, which is revolutionizing the art of selecting yarns

for textiles. Immature fibres show shades of colour in different places. Rayon shows these phenomena in the same way as cotton, and even weaving does not destroy the evidence.

177. AUTOMATIC LOOMS: HISTORY. By J. C. Brooks. (*Rayon Text. Monthly*, **18**, 1937, p. 119. From *J. Text. Inst.*, xxviii., **7**, 1937, A367.) The history of automatic looms in the U.S.A. from about 1834 is briefly reviewed. The shuttle-changing principle was developed first, but Northrup's inventions of bobbin-changing looms (1891 onwards) soon caused his firm, the Draper Co., to concentrate on the new type. By 1904 they had acquired about 625 patents by 160 different inventors.

178. SHIRLEY LINT RECOVERER. By Howard and Bullough, Ltd. (*Text. Wkly.*, xx., **488**, 1937, p. 43.) An illustrated account is given of the construction of the Shirley Lint Recoverer, employing the stream-lined air current.

179. COTTON OPENING MACHINERY. By Howard and Bullough, Ltd. (*Text. Merc. and Argus*, **97**, 1937, p. 54. From *J. Text. Inst.*, xxviii., **9**, 1937, A487.) An illustrated account of recent improvements in opening machinery, including the No. 4 upstroke porcupine opener with Shirley cage, a horizontal exhaust opener, the No. 12 hopper feeder with reserve bin and overflow battery, and a system of automatic electric control for the multiple feeding or finisher scutchers.

180. THE ABSORPTION OF WATER BY CELLULOSE AND CELLULOSE COMPOUNDS. By J. Tankard. (*J. Text. Inst.*, xxviii., **9**, 1937, T263.) The various theories which have been advanced to explain the phenomena associated with the absorption of water by cellulose and cellulose compounds are reviewed, and some reference is made to the experimental work upon which these theories are based. The method of Champetier for the determination of water of hydration is discussed in detail, and his method has been applied to the study of the absorption of water by cellulose and a number of cellulose compounds.

It is suggested that the results of these experiments do not indicate that cellulose and its compounds form a limited number of definite hydrates, but that there is, for each of the substances examined, a maximum amount of water which can be regarded as entering into chemical combination. This maximum value corresponds to 0·5 molecule H_2O per molecule $C_6H_{10}O_5$ in the case of bleached cotton and linen cellulose; 0·75 molecule H_2O per molecule $C_6H_{10}O_5$ for mercerized cotton cellulose which has been dried subsequent to mercerization; and 1·0 molecule H_2O per molecule $C_6H_{10}O_5$ for mercerized cotton cellulose which has not been dried after mercerization, for mercerized linen cellulose whether dried or not after mercerization, and for regenerated (viscose) cellulose. The results obtained with cellulose acetate suggest a value of 3·0 molecules H_2O per hexose unit for cellulose tri-acetate, and a similar value is obtained with cellulose monomethylene ether.

181. COTTON PLANT UTILIZATION. By F. K. Cameron. (*Cotton Trade J.*, xvii., **18**, Internat. Edn., 1937, p. 112. From *Summ. of Curr. Lit.*, xvii., **17**, 1937, p. 494.) An account is given of experimental investigations of the possibilities of harvesting the whole cotton plant, recovering the oil in the seeds and preparing an alpha-cellulose pulp from the residue. Plants were crowded together to induce early maturity and ripening of the major part of the bolls within a few days, and the plants were harvested by cutting with the ordinary mowing machine used in harvesting hay and grains, and made into bales. Bales could be stored for at least five years without deterioration, but the settling of dust and grit on them results in a high silica content in the cellulose pulp. The air-dried whole cotton is easily and cheaply reduced to a comminuted fluffy mass in a mill of the hammer type used for pulverizing clover, straw, etc. The

product is not well suited to the recovery of the oil from the seeds in the press, but is admirably adapted to extraction by oil solvents, a process which usually gives a higher yield than does pressing. The extracted residue may be used for the preparation of cellulose pulp. The nitric acid process has yielded promising results in laboratory studies. No significant differences have been observed in cellulose and cellulose derivatives prepared from lint, cusps, and stems of cotton and from spruce, pine, and poplar.

182. Cotton Plant: Utilization for Cellulose. By A. B. Macormac. (*Amer. Dyes. Rept.*, **26**, 1937, p. 389. From *Summ. of Curr. Lit.*, xvii., **17**, 1937, p. 494.) A report of a lecture describing the possibilities of utilizing the whole cotton plant as a source of a-cellulose. A yield of about 55 per cent. appears to be possible, including about 20 per cent. from the cotton fibre borne by the mature plant. A discussion is reported.

TRADE, PRICES, NEW USES.

183. The Financing of the Growing and Marketing of Cotton. By G. Costanzo. (*Mo. Bull. Agr. Econ. and Soc.*, 27, **2**, Rome, 1936. From *Exp. Sta. Rec.*, 77, **2**, 1937, p. 261.) Describes the systems of financing in the United States, India, Egypt, Russia, China, Argentina, Brazil, Turkey, and other countries.

184. Cotton Importing, Finance and Marketing. By F. Cook. (*The Accountant*, 16/10/37, p. 520.) A clear and most readable account given under the following headings: Finance; arrival of the cotton; warehousing; marketing; cotton bank, clearing-house and futures market; hedging; bureau reports; premiums and discounts; straddles; dockets; trading accounts; contracts for deferred delivery.

185. Statistics Relating to International Trade in Cotton and Linters, 1921-35. By C. G. Gries and A. T. Turner. (*U.S. Dpt. Agr., Bur. Agr. Econ.*, 1936. From *Exp. Sta. Rec.*, 77, **1**, 1937, p. 123.) Presents in detail the export and import trade in unmanufactured cotton from 1921-35 for all countries in which such trade is significant. As of additional value, average exports and imports for 1909-13 have also been included in the summary tables. These statistics have been taken from the official publications of the various countries, supplemented in a few cases by reports from United States representatives abroad.

186. British Textile Trades: National Importance. By B. Ellinger. (*Times Trade and Eng.*, **41**, May, 1937, p. 11. From *Summ. of Curr. Lit.*, xvii., **14**, 1937, p. 424.) The 1935 "Census of Production" and other figures are analysed to demonstrate the national importance of the textile industries. The manufacture of textiles and clothing employs about 1,677,000 persons, second only to "distribution" with 2,007,000 persons. Cotton engages nearly 33 per cent., wool nearly 25 per cent., hosiery 10 per cent., silk and rayon 8 per cent., and linen and hemp 7 per cent. of the 1,050,000 persons employed in textile manufacturing. The value of the "work done" in 1935 was £443,656,000, of which £117,000,000 represented exported goods.

187. Early Development in Co-operative Cotton Marketing. By O. W. Herrmann and C. Gardner. (*Farm Credit Admin., U.S. Co-op. Div. Circ.* C-101, 1936. From *Exp. Sta. Rec.*, 76, **5**, 1937, p. 712.) The development of co-operative cotton marketing under the Grange and Farmers' Alliance, the activities of early cotton associations, the cotton marketing efforts of the Farmers Union, the development of independent associations, the organization

of the American Cotton Association, large-scale state and regional associations, the American Cotton Growers' Exchange and the American Cotton Co-operative Association, and the establishment of co-operative gin associations and cotton-seed oil mills, are discussed.

LEGISLATION.

188. Kenya: *The Kenya Cotton Rules*, 1937. (*Government Notice No.* 273, 20/3/37.) Gives the rules governing the growing, buying, and ginning of cotton in Kenya Colony.

189. Nigeria: *Cotton Marketing Regulations*, 1935. (*No.* 25, 22/7/35.) These regulations apply to the Northern Provinces, and deal with the control of cotton marketing, measures with regard to licences to buy seed cotton, scale fees, etc.

Regulation No. 28 *of* 1935 (16/9/35). Amends Regulation 25 of the Cotton Export Regulations, 1926.

190. Nyasaland: *Cotton Ordinance No.* 16 *of* 1934 was amended in 1936 to limit the number of agents purchasing raw cotton at any one market; to postpone the date on which applications for registration should be received by District Commissioners; to reduce the period for which licences to purchase are valid, etc.

191. Southern Rhodesia: *Cotton Pest Prevention Act*, 1937. (*No.* 5, 1937.) Provides for the prevention of the spread of certain cotton pests by prohibiting the practices of ratooning cotton plants and of allowing cotton plants to remain in the ground from one growing season to another.

192. St. Vincent, West Indies: *Order in Council.* (*Gazetted* 17/4/37.) Declares the " Close Season " for cotton, previous to which all cotton and ochro plants must be destroyed.

MISCELLANEOUS.

193. Skinner's Cotton Trade Directory of the World, 1937-38. (Pubd. annually in October by Thos. Skinner and Co. (Publishers), Ltd., London, Manchester, Bradford, New York, and Montreal.) The fifteenth issue of this invaluable work contains information relating to the cotton industry and trade of every country in the world. The customary revision of details, in collaboration with the leading Textile Associations throughout the world, has been carried through, and valuable additions have been made to the information previously published; in particular, the editorial relating to foreign companies has been considerably augmented. The Hosiery and Knit Goods Manufacturers Section has been completely revised and materially extended, and now contains a geographical index of hosiery and knit goods manufacturers; lists of cotton, silk, rayon, woollen and worsted hosiery yarn spinners and doublers; hosiery yarn and fabric dyers and finishers; goods manufactured; and information concerning hosiery machine and accessory manufacturers. The thumb-holes for easy reference are labelled: Contents; Index; Exporters, Merchants; Spinners, Manufacturers and Doublers; Directors (British); Dyers, Finishers; Fabrics; Silk and Rayon; Hosiery and Knit Goods; Mill Supplies. All headings, indices and explanatory notes are, as usual, printed in English, French, German, Italian, Spanish and Portuguese. The directory is absolutely indispensable to those concerned in any way with the cotton industry. The price by post, inland and abroad, is £1, Canada and United States, $7 (post and duty free).

194. Annual Cotton Handbook, 1937. (Compiled and published by Comtelburo Ltd., London, E.C. 2. Price 5s. 2d. post free.) We have received a copy of

the sixty-seventh edition of this useful publication for recording daily the receipts and quotations of American, East Indian, and Egyptian crops. Many statistical tables are also included in the volume. A new feature of this edition consists of four pages giving the monthly arrivals and stocks in the Japanese ports and in Shanghai for two seasons. As the contract for Egyptian F. G. F. Sakellaridis expires shortly, this has been omitted, its place being taken by the new Egyptian Cotton Giza No. 7 contract. The "Empire and Miscellaneous" contract is also omitted, this no longer being quoted.

195. AGRICULTURAL OUTLOOK CHARTS, 1938. (*U.S. Dpt. Agr., Bur. Agr. Econ.*, October, 1937.) *Cotton.* A useful set of charts of world production and carry-over; mill consumption in the principal countries of the world; farm prices and gross income from cotton and cottonseed from 1909-10 to date, etc.

ADDENDA.

196. COTTON PEST CONTROL WORK IN SOUTHERN AND CENTRAL AFRICA AND THE RHODESIAS. By J. W. Munro. (Pubd. by the Empire Cotton Growing Corporation. 1937. Price 2s. 6d. post free.) Professor Munro has lately visited the South and East African Stations of the Corporation to determine how far the work already done towards the control of insect pests of cotton promised reasonable practical results; whether that work should be extended, modified, or restricted, to what extent and in what direction. He is very eulogistic of the work that is being carried out, and considers it is distinctly upon the right lines, and well conducted. This reports deals with the work of the individual stations, followed by a general discussion of the pest-control work as a whole, and an outline of the programmes of future work.

197. THE AFRICAN AND THE CINEMA. AN ACCOUNT OF THE WORK OF THE BANTU EDUCATIONAL CINEMA EXPERIMENT, MARCH, 1935 TO MAY, 1937. By L. A. Notcutt and G. C. Latham. (Pubd. by Edinburgh House Press, London, S.W. 1. 1937. Price 3s. 6d. net, 4s. post free.) The object of the valuable experiment described was to ascertain by actual trial whether films made on the spot with African actors and African scenery would attract African audiences, especially the more primitive rural communities, and to what extent the films could contain instruction, both moral and material. The report records the unanimous verdict of Government, educational and other officials as to the success and value of the experiment. It is urged that Government should take charge of the film industry in connection with the natives and ensure the provision of good films for entertainment as well as for education.

Among the films prepared for these experiments were some dealing with soil erosion, health, taxation, peasant holdings, improved agriculture, coffee-marketing, etc.

198. WORLD COTTON PRODUCTION AND TRADE. (*Studies of the Principal Agricultural Products on the World Market, No.* 1, Int. Inst. of Agr., Rome, 1936. Price 30 lire.) This volume is the first of a new series initiated in response to an American suggestion, with a view to "harmonizing with present changed world conditions the economic and statistical services rendered by the International Institute of Agriculture, and of increasing their effectiveness." Part I. deals with the Geography of Cotton Production, and discusses the humid and sub-humid zones of rain-grown cotton; the arid or semi-arid zones of irrigated cotton; the national aspects of cotton production. Considerable space is given to the decline in production in the Southern United States and the contributory causes; to India, and its various types of soils; to Brazil and to Egypt. In Part II. the Conditions of Marketing and Movement of Prices are considered,

with the policies pursued by the Governments in America and Egypt. In Part III. the Evolution of the World Cotton Trade is discussed, with the effects produced by American and other legislation; finally, in Part IV., the Cotton Industry as a whole is dealt with under the different countries, American, European and Asiatic.

199. APPLIED MYCOLOGY AND BACTERIOLOGY. By L. D. Galloway and R. Burgess. (Pubd. Leonard Hill Ltd., 17, Stratford Place, W. 1, 1937. Price 10s.) In this book the authors have endeavoured to fill a need often felt by chemical, medical and agricultural workers who desire occasional enlightenment on some point concerned with micro-organisms. It is by no means a mere summary of previous literature, but contains many hints and suggestions arising out of the authors' very considerable experience. Part I. gives a concise and up-to-date account of bacteria and fungi, together with the basic technique for their examination, identification and control. Part II. is devoted to specific applications to the food, fermentation and textile industries, to hygiene and medicine, agriculture, etc. Some 270 carefully chosen references are given and the book is well indexed.

PERSONAL NOTES

We regret to announce the deaths of Mr. Edward B. Orme, a Vice-President of the Administrative Council of the Corporation since 1922; of Mr. Frank Wright, who was an original member of the Council, and for some years served on the Executive Committee; of Mr. Harold Cliff, also a member of the Administrative Council since its inception.

APPOINTMENTS

NYASALAND

Mr. A. L. Cran has been appointed by the Corporation as Farm Manager serving under Mr. Ducker in Nyasaland.

SOUTH AFRICA

Dr. R. C. Rainey has been appointed by the Corporation as an Insect Physiologist to work at Barberton on a programme of research outlined by Professor Munro.

OFFICERS ON LEAVE

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the time of writing the following officers are on leave in this country from cotton-growing countries:

Ceylon	Mr. G. Harbord.
"	Mr. T. H. Parsons.
Gold Coast	Mr. A. W. Paterson.
"	Mr. J. L. Scott.
Kenya Colony	Mr. E. W. Gaddum.
"	Mr. M. H. Grieve.
Nigeria	Mr. B. G. Owen.
Nyasaland	Mr. R. E. Jackson.
"	Mr. R. W. Kettlewell.
"	Mr. D. N. Smalley.
Tanganyika Territory	Mr. J. C. Eyre.
" "	Mr. P. J. Greenway.
" "	Mr. B. Notley.
" "	Mr. F. J. Nutman.
" "	Mr. N. V. Rounce.
" "	Mr. A. S. Stenhouse.
Uganda	Mr. T. R. Hayes.
"	Mr. W. J. M. Irving.
"	Mr. H. G. Smith.
"	Mr. A. S. Thomas.
West Indies: *St. Vincent*	Mr. A. K. Briant.

The following officers of the Corporation's staff abroad are on leave in this country:

Nyasaland	Mr. W. L. Miller.
Southern Rhodesia	Mr. G. S. Cameron.

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THE INDIAN CENTRAL COTTON COMMITTEE AND ITS WORK

BY

SIR BRYCE BURT AND D. N. MAHTA.

A BRIEF account of the work of the Indian Central Cotton Committee was given in the first number of Vol. I., 1924, of the EMPIRE COTTON GROWING REVIEW, and an account of the progress made in cotton growing in India in April, Vol. IV., 1927. As is now well known, the Central Cotton Committee's activities extend to all branches of cotton improvement in India. The Committee aims at supplementing, and not supplanting, the work of the Agricultural Departments in the cotton-growing provinces and Indian States. Though, as a matter of convenience, the Committee has laid down certain lines of demarcation regarding the investigations which it considers appropriate for its grants, the general policy has been to give assistance in the directions where it is most needed in the carrying out of a co-ordinated policy of cotton improvement. In consequence one cannot always attribute the credit for particular advances to the Committee or Departments with any precision. Broadly it can be stated that the marked developments in Indian cotton cultivation, which have taken place during the last few years, have resulted in a very large measure from the work of the Provincial Departments of Agriculture and that much more has been done than would have been possible had no assistance from the Committee been forthcoming. In short, the latter's relations with the Agricultural Departments can best be described as symbiosis. For a considerable period, the Committee restricted its grants to agricultural research, but in 1930 it was decided that the time had come to add its support to the efforts already being made to bridge the gap between the experiment station and the cultivator and to supplement the funds which the Agricultural Departments were devoting to the introduction of improvements into agricultural practice. Special attention was devoted to seed introduction schemes.

The agencies employed by the Committee for its research work have varied little in character since 1923 though they have grown in number. It continues to maintain a central Technological Laboratory at Bombay, the work of which is now well known; it also provides a large proportion of the funds of the Indore Institute of Plant Industry, where Mr. Hutchinson's recent work on the Asiatic cottons was carried out; and it continues to make grants to Provincial and State Departments of Agriculture for specific purposes.

The Committee has not stopped at the production of better cotton, but from its inception has devoted special attention to better marketing (in the widest sense of the word), to the prevention of adulteration and other abuses and to many other problems connected with the cotton trade of the country. Including as it does representatives of growers, agricultural officers, traders, spinners and manufacturers, it has been an invaluable forum for the discussion of many problems of general concern. The ever-increasing understanding which has arisen from the association of leading commercial representatives with growers and research workers has led to developments which at one time seemed impossible, whilst as an authoritative body to advise the Central and Provincial Governments on the important matters of cotton policy the Committee has attained an outstanding position. It may be stated without hesitation that much of the success has been due firstly to the way in which leaders of the commercial community, both Indian and European, have given freely of their time and knowledge to the Committee's work and to its day-by-day administration, whilst the readiness with which trade associations, particularly the East India Cotton Association, have taken action on recommendations designed to benefit the cotton grower, has made its task much easier. A further advance was made when the Committee was given the right to nominate two representatives of the cotton growers to the Board of the East India Cotton Association.

In reviewing briefly the results of these co-operative efforts to improve Indian cotton it may be stated without hesitation that the last fifteen years have seen a marked change in the character of the Indian cotton crop, particularly in the percentage of short and medium staple. This is illustrated in the table on the opposite page.

Equally important is the result of agricultural research and its application to the yield of cotton per acre, and Table II. shows what has been achieved in this respect.

It will be seen that the average yield per acre in the quinquennium 1932-37, for the whole country, is 11 per cent. higher than for the

TABLE I.—INDIAN COTTON CROP CLASSIFIED ACCORDING TO VARIETIES AND LENGTH OF STAPLE, 1932-37.

(Based chiefly on the "Estimates of Area and Yield of Principal Crops in India" and "Cotton Forecasts" published by the Department of Commercial Intelligence and Statistics in India.)

In Thousand Bales* of 400 lbs. Each.

Trade Descriptions.	*Average of* 1932–33 *to* 1934–35.	1935–36.	1936–37.	*Percentage Increase of* 1936–37 *Crop over the Average of* 1932–33 *to* 1934–35.
Short Staple, below 7/8 *Inch.*				
1. Oomras, Khandesh	243	293	271	—
2. Oomras, Central India	203	301	306	—
3. Oomras, Barsi and Nagar ...	349	432	332	—
4. Oomras, Central Provinces and Berar	712†	587†	773†	—
5. Broach (Part)	87	188	133	—
6. Westerns and Northerns (Part)	— (*a*)	140	118	—
7. Kumpta-Dharwar (Part) ...	— (*a*)	5	13	—
8. Dholleras	625	621	521	—
9. Bengals, United Provinces ...	210	196	177	—
10. Bengals, Rajputana	74	92	85	—
11. Bengals, Sind-Punjab	827	1,039	1,251	—
12. Bengals, Others	14	13	9	—
13. Comillas, Burmas, etc.	126	144	152	—
14. Salems	35	30	37	—
15. Coconadas	27	25	27	—
Total, Short Staple ...	3,532	4,106	4,205	19
Medium and Long Staple, 7/8 *Inch and Above.*				
16. Oomras, Hyderabad Gaorani ...	138	112	141	—
17. Oomras, Verum selections ...	20	29	37	—
18. Broach (Part)	147	154	191	—
19. Kumpta-Dharwar (Part) ...	183	156	138	—
20. Westerns and Northerns (Part)	181	155	47	—
21. Tinnevellies (including Karunganni)	135	137	155	—
22. Cambodias	163	192	202	—
23. Americans (Punjab and Sind) 4F	364	807	1,033	—
24. Punjab American 289F/43 ...	—	—	11	—
25. Punjab American 289F‡ ...	11	20	47	—
26. Sind American 289F‡	— (*b*)	65	100§	—
Total, Medium and Long Staple	1,342	1,827	2,102	57
Grand Total	4,874	5,933	6,307	29

* Statistical bales containing 400 lbs. of cleaned (lint) cotton.
† Excludes Verum selections. ‡ Staple length over 1 inch.
§ From 1936-37 classed as 1 inch in staple.
(*a*) Included under item 20. (*b*) Included under item 23.

TABLE II.

Year (September 1st to August 31st).	*Area (Thousand Acres).*	*Production. Government Estimates (Thousand Bales of 400 Lbs. Each).*	*Yield per Acre (Lbs.).*	*Production of Cotton (Based on Government Estimates. Staple 7/8 Inch and Above).*		*Commercial Crop (Thousand Bales of 400 Lbs. Each).*	*Yield per Acre calculated from Commercial Crop. Col. 7 : Col. 2 (Lbs.).*
				Actual (Thousand Bales of 400 Lbs. Each.)	*Per Cent. on Total.*		
1.	2.	3.	4.	5.	6.	7.	8.
Average 1922–27	25,092	5,512	88	1,622	29·3	6,254	100
Average 1927–32	25,054	5,244	83	1,348	26·1	6,151	98
1932–33	22,483	4,657	83	1,347	28·9	5,979	106
1933–34	24,137	5,108	85	1,365	26·7	6,492	108
1934–35	23,972	4,857	81	1,244	25·6	6,477	108
1935–36	25,999	5,933	91	1,827	30·8	7,254	112
1936–37	25,219	6,307	100	2,102	33·3	*7,642	121
Average 1932–37	24,362	5,372	88	1,577	29·1	6,769	111

* Excludes Burma.

quinquennium 1927-32, despite the fact that in two years of the last quinquennium the cotton crop in some important areas was seriously damaged by abnormal weather conditions. The ascertained area under improved cottons was 21 per cent. of the total in 1935-36 and the gain to the cultivator in many tracts was clearly much greater.

The period 1932-37 has seen important developments in the Indian textile industry, resulting in increased takings of Indian cotton and a greater demand for cotton of medium and long staple. It has also seen a large increase in the taking of Indian cotton by mills in the United Kingdom, largely due to the efforts of the Lancashire Indian Cotton Committee, an organization set up as a result of the Ottawa Agreement of 1932. This will be clear from the following table:

TABLE III.—IMPORTS OF INDIAN COTTON INTO THE UNITED KINGDOM, IN THOUSANDS OF BALES, YEARS ENDING 31ST JULY.

1933.	1934.	1935.	1936.	1937.
230	362	394	547	658

Despite the increased production, and consequent exportable surplus, of cottons of 7/8 inch staple and over, India's cotton exports still consist mainly of short-staple types for which Japan has been the most important market. It is satisfactory to note that the imports and utilization of these short-staple cottons in the United Kingdom, due to the improvements in technique resulting from the work of the Shirley Institute and the Lancashire Committee, have steadily risen during the two years ending July, 1937. What is still more satisfactory is that the changes which have taken place have done so on a sound economic basis, and that Indian cotton has found definite new outlets in the United Kingdom which, it is hoped, will be permanent.

Nevertheless, the Committee's policy of aiming at a better balance of medium and short-staple types has been amply justified, and it is appropriate here to mention the progress made in the Punjab and Sind. Milne's original work leading to the establishment of the types of Punjab-American, particularly 4F, is now so well known as to call for no further comment than to point out that the area under Punjab-American and Sind-American cottons in 1937-38 was no less than 2,424,000 acres, mainly of Milne's type 4F and 289F or strains selected from them. Since the Committee started its work the proposed Sukkur Barrage has become a reality and the area under irrigated cotton in Sind has now risen to the project level. Special steps have been taken there to establish a compact block of 300,000 acres of American cotton mainly of the 289F type or other agricultural strains of similar staple and character.

For India as a whole the *ascertained* area under improved strains of cotton in 1935-36 was 5,216,000 acres or 21 per cent. of the total. The figures for 1936-37 are not yet complete, but are similar. Nor is this the whole of the story, since it is known that these departmental varieties have spread in varying states of purity over a much greater area. The ultimate ideal is to encourage the establishment of single-variety tracts wherever agricultural conditions and the limitations of irrigation supply and soil make this possible. Reference has already been made to the single-variety cotton area which has been established in Sind. In Gujerat the now famous 1027A.L.F. strain of Surat cotton is maintained in a state of purity over very substantial areas through the combined operation of the Cotton Transport Act and a special organization for seed supply controlled by the Agricultural Department and aided by a grant from the Committee. Similarly in the Southern Division of the Bombay Presidency the Committee has financed special arrangements for the multiplication and distribution of improved types of Kumpta and Dharwar-American cotton. In the Cambodia cotton area in Madras, privately-owned seed farms under departmental supervision are being assisted, the kapas being ginned under supervision to provide the seed for bulk distribution through co-operative and other agencies. The Rajpipla State, which adjoins the Surat tract, has forbidden the cultivation of any type of cotton other than 1027A.L.F., with a consequent increase in the reputation of its cotton and in the average price received for it. The Baroda State, whose territory is interlaced with British Gujerat, has also co-operated in the 1027 seed distribution scheme. Further, owing to the threatened invasion of long-staple cotton areas by a short-staple high ginning *herbaceum* cotton, locally known as Goghari, the Bombay Government in 1935 passed the Cotton Control Act, which made the cultivation, mixing or possession of Goghari cotton a punishable offence in specified areas. The Madras Government indeed had taken similar action three years earlier when in 1932 it passed the Madras Cotton Control Act prohibiting the cultivation and mixing of the short-staple *Neglectum* cotton, locally known as Pulichai, in the long-staple cotton-growing tracts producing Tinnevellies, Karungannis and Cambodias. Quite recently the Central Provinces Government enacted a Cotton Control Act to eradicate a very inferior short-staple prolific cotton commonly known as Garo Hill, introduced from outside the province, which threatened to stultify their efforts for cotton improvement. These clean-up measures are to a considerable extent supplementary to the Cotton Transport Act passed in 1923 by which Local Governments were empowered to

exclude from any specified area cotton, kapas or seed from outside, unless required for a special purpose and covered by a licence. Under this Act, protected areas have been established in the Bombay Presidency, in the Madras Presidency, in the Central Provinces and Berar and in the following Indian States: Hyderabad, Baroda, Indore, Sangli, Rajpipla, Chota Udepur and Baria. The Cotton Ginning and Pressing Factories Act, 1925, applies to the whole of British India, and practically all cotton-growing Indian States have passed parallel legislation. This Act requires every bale of cotton to be stamped with a mark showing where it was pressed; certain other matters dealing with the management of ginning and pressing factories were dealt with and regular returns of cotton pressed each week were made compulsory. Modifications in the rules have been called for from time to time, but the working of the Act has undoubtedly been a salutary check on occasional malpractices. The original Indian Cotton Committee, of which Sir Frank Noyce (then Mr. Noyce) was Secretary, also recommended the actual licensing of gins and presses in order to deal more effectively with such abuses as false packing, watering, mixing and excessive seed. This further deterrent to malpractices has been provided by provincial legislation in Bombay, the Central Provinces and Sind. The above Act, as it applies to those provinces, contains specific provision against watering and mixing. There has without doubt been a steady improvement in the purity of Indian cotton during the last twelve years due not only to the legislation referred to, but to the firm action taken by the East India Cotton Association to penalize watered, mixed or false packed cotton when tendered against their contracts.

The Committee has devoted much attention to the improvement of primary cotton marketing and with considerable success. Regulated cotton markets existed in Berar before the establishment of the Central Cotton Committee, and that system which had stood the test of time was commended with certain modifications for general adoption. The Bombay Presidency was the first to pass a Cotton Market Act and a number of regulated markets have been established. In the Central Provinces an Act bringing the markets in the Central Provinces proper into line with Berar was passed with some further improvements, the Bill being sponsored by a member of the Central Cotton Committee who was also a member of the Local Legislature. The Berar Marketing Act and rules were subsequently improved. In Madras a Marketing Act which includes cotton has been passed, though so far only one regulated market has been notified. In Hyberabad, Indore and several other Indian States similar laws have been passed

and open markets established. During the period 1924-26 the Central Cotton Committee carried out a number of local surveys of cotton marketing, and the fact was established beyond doubt that in those tracts where regulated markets existed these markets were being used by cultivators themselves to the extent of some 50 per cent. of the arrivals, and that the prices obtained even when cotton was sold in villages were far better than in immediately adjoining and similar tracts which were not linked up with regular markets. This first-hand information justified the Committee in recommending all provincial Governments to adopt the regulated markets system. The latest development in this direction is the provision by the Committee, in co-operation with All-India Radio, of a limited number of rural broadcast receivers in suitable markets for the broadcasting of cotton prices.

The funds of the Central Cotton Committee are derived from the cotton cess of two annas per bale (four annas for the first three years) which was imposed in 1923. Having complete control over its funds, the Committee has been able to build up a satisfactory reserve and is at present spending some £80,000 per annum on cotton improvement, mainly on agricultural and technological research and seed distribution schemes.

Some of these projects may now be described very briefly. Plant breeding schemes for the improvement of quality naturally take pride of place. Among them may be mentioned the appointment of a Cotton Research Botanist and staff in the Punjab for cotton improvement work on both American and *desi* cottons. The first holder of this post was Mr. Trevor Trought, well known to readers of this journal for his work in Egypt and in the Sudan. The present occupant, Mr. Muhammad Afzal, after working under Mr. Trevor Trought, studied at the Imperial College of Agriculture, Trinidad, and was given facilities at the Empire Cotton Corporation's research station in that island. Cotton breeding and the testing of varieties were placed on a satisfactory basis, with the whole-hearted co-operation of the Punjab Department of Agriculture, and several important new strains have resulted and are passing into general cultivation. Of these the most important is Punjab 43F (now known as 289F43 to indicate its parentage) which in the current year occupies some 70,000 acres. This cotton is relatively resistant to jassid, has yielded well in a comprehensive series of replicated trials both on the experimental farms and on zamindars' holdings, has a full one-inch staple and is suitable for spinning 35's-40's standard warp counts as against 21's from 4F under comparable conditions. A later

strain, 289F47, is still undergoing final field tests, and appears even superior in yield, ginning outturn and hardiness, and is capable of spinning up to 50's standard warp counts. A new strain of an indigenous type, 30 Mollisoni, is an improvement on the original selection and is spreading rapidly in certain tracts, whilst a hybrid between the same cotton and the Chinese cotton known as "Million Dollar" shows good promise. Simultaneously a study of the periodic partial cotton failures which occur in the Punjab was started by the Cotton Research Botanist and in 1935 a special investigation by a physiologist (Professor Dastur) was commenced. Bacteriological and biochemical investigations are still in progress and some promising lines of field experiments are now defined. Invaluable assistance was rendered recently by Dr. Mason, F.R.S., the Empire Cotton Growing Corporation's physiologist at Trinidad, whose services were kindly given by the Corporation for several months during 1937.

In the Bombay Presidency cotton breeding schemes have been running for some years in the Broach cotton tract and in Khandesh. The Bombay Department is itself maintaining similar work in the Kumpta-Dharwar area and in Surat. Recently a botanical survey of the Dholleras cottons of Gujerat and Kathiawar has been commenced with the aid of a grant from the Committee. The Broach scheme has been running for nearly six years and some very promising strains have emerged which are now undergoing tests. The selection known as B.D. 8 occupied 20,000 acres in 1935-37 and 4,500 bales were sold at premiums ranging from Rs. 37 to Rs. 58 per candy of 784 lbs. *on* Broach. In Khandesh a type now known as Jarila, capable of spinning 35's standard warp counts, is being multiplied for distribution and is intended to replace the local *Neglectum roseum* which spins 7's and the earlier improved cotton Banilla which spins 15's. In all these breeding schemes yield per acre and ginning percentage naturally receive constant attention. In Madras, cotton-breeding work in the Cambodia and Tinnevellies areas is provided for by the provincial agricultural department. The Committee has financed a scheme for the study of the *herbaceum* cotton (Northerns and Westerns) with a view to securing further improvement in staple. Promising hybrids are now undergoing the final stage of testing. The Committee is also financing experimental work in Madras on methods of dealing with the insect pest *Pempheres* (the cotton-stem weevil), including the breeding of types which are either less susceptible to attack or have greater power of recovery. Another interesting breeding scheme is that on Nadam, a perennial cotton, from which it is hoped to evolve an annual strain in view of the diffi-

culty which Nadam cotton causes by encouraging both the stem-weevil and pink boll-worm. In the Hyderabad State the Committee has financed for some years a comprehensive botanical research work which included the survey of Hyderabad cottons, the results of which are now in press. The main object of the breeding work has been to evolve from the mixed Hyderabad Gaorani cotton (a valuable staple cotton believed to be the original *Gossypium indicum*) pure strains with better ginning outturn and higher yield. The best of these are now undergoing comparative field trials. In the Central Provinces, for many years, a short-staple high-ginning type was encouraged by the agricultural department as being profitable to the cultivator; it was, however, susceptible to wilt and met with only a limited demand from spinners. A study of the indigenous Central Provinces cottons, especially the type classified by Gammie as *Gossypium neglectum verum*, led to the isolation of several strains of greatly improved value. The best all-round type, Verum 434, is hardy and prolific and spins up to 33's standard warp counts. This cotton is expected to occupy 200,000 acres in the coming year. Earlier Verum selections which were a great advance on the cottons they replaced now occupy a very large area. As the result of a combined seed production and marketing scheme, pure seed of Verum cotton sufficient for 118,000 acres was distributed in 1937-38. During the five years ending 1936-37 Verum cottons fetched an average premium of Rs. 35 per candy *above* Broach, whereas fine Oomra is usually Rs. 20 per candy (of 784 lbs.) *off* Broach. Other plant-breeding schemes include work in the United Provinces and in Bengal.

The botanical work at the Indore Institute of Plant Industry under Mr. Hutchinson has dealt more particularly with cotton genetics and the modern classification of Indian cottons. This work is of fundamental value to cotton breeders throughout India. Simultaneously work has been carried out on the improvement of several of the Central India cottons with satisfactory results. Work on cotton diseases has mainly been limited to investigation of wilt. A comprehensive scheme in the Bombay Presidency was financed for a number of years and the results have been published recently. The study of this problem is still continuing in Baroda and at Indore. In the Punjab a scheme of work on the root rot disease of cotton has been in progress since 1936.

Entomological work on cotton pests has been mainly concerned with the boll-worms, white fly and *Pempheres* (the cotton-stem weevil), Mention may also be made of the measures taken by the Committee to prevent the introduction of the American cotton boll weevil into

India with imported American cotton. Enquiries having shown that a definite risk existed, a practical scheme of fumigation was worked out at the Technological Laboratory in consultation with the Bombay Port Trust. The Government of India, on the recommendation of the Committee in 1925, required all American cotton to be fumigated prior to landing. This procedure has been continued under the Committee's technical supervision. The scheme is a self-supporting one, the cost being met by a small levy on each bale of American cotton imported. Doubts having been expressed at one time as to the need for these precautions, it is of interest to note that dead boll-weevils were actually found in the sacking of the fumigated bales.

The pink boll-worm is indigenous to India and is most injurious in the United Provinces. By a comprehensive scheme of research the precise status of the pest was determined, the amount of damage evaluated, and it was established that control could be effected provided that all seed was heat-treated. Various forms of heat treatment were tested and subsequent demonstrations carried out on a large scale in controlled areas. In 1937-38 the area so controlled was over 50,000 acres of cotton, all of which was sown with heat treated seed. The increase in the gross value of the crop was approximately Rs. 10 lakhs. The United Provinces Cotton Pest Control Act provided legislative sanction to compulsory control measures. Work on the pink boll-worm was also carried out in the Punjab where simple methods of heat treatment were worked out, observations were made on the life history and bionomics of the pest and on some very interesting climatic limitations on its intensity and spread. In Madras, the only other area where pink boll-worm is believed to be of major importance at present, control is effected through a Pest Act since, unlike Northern India, the carry-over is not due to long-cycle larvæ. Experimental work on this pest in the Central Provinces and Hyderabad also is being financed by the Committee. In Gujerat work was financed for some seven years on the spotted boll-worm (*Earias*) with successful results. The main method of control was found to be the systematic uprooting of plants at the end of the season. A suitable cheap plant puller was designed and the Committee financed demonstrations and subsequent clean-up measures over an area of many square miles.

It was shown by extensive caging experiments that protection from the spotted boll-worm gave an increase of yield of 25 to 30 per cent. and made the crop anything up to six weeks earlier. This investigation showed that much of the early shedding of buds, flowers and bolls was due to the attack of this pest. Simultaneously

a physiological investigation was carried out on bud and boll shedding under protected conditions, the results of which have been published.

A brief reference may now be made to the Committee's Technological Laboratory, which is unique in that its primary function is the testing, by fibre measurements and actual spinning trials, of new varieties of cotton prior to their introduction into cultivation, and at as early a stage as possible in the plant breeder's work. This has been of the greatest value in assisting the cotton breeder to reduce his collection to a manageable size at a relatively early stage, and in indicating which strains of cotton are worth putting through extensive field trials with a view to introduction into general cultivation. The Laboratory's second main line of work has been the correlation of fibre properties with spinning performance and the working out of a prediction formula, for the Indian cottons, showing the probable spinning behaviour of a cotton with particular fibre measurements. The effect of season on a number of standard Indian cottons has been studied for a number of years. This has indicated the range of seasonal fluctuations and disposed of the bogey that, even if the purity of seed supply is maintained, improved cottons deteriorate. Problems of importance to Indian mills and several problems connected with the storage and handling of cottons have been investigated in the Laboratory. In dealing with the thorny question of moisture in cotton the Laboratory has rendered most important assistance and it is now the official testing house for the East India Cotton Association. The Committee's test results on the standard cottons and the commercial types of each season are made available to the cotton trade both in India and abroad as early as possible and have been widely appreciated.

This account of the Committee's activities is necessarily brief, but it can legitimately be claimed that the work of the last fifteen years has been successful. As an organization for cotton research its operations were warmly commended by the Royal Commission on Agriculture in India, and it presents an admirable example of what can be done to promote the well-being of the cotton crop by the combined efforts of the textile industry, the cotton trade, representatives of the grower, and the Agricultural Departments.

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FINANCE, AMERICA AND COTTON PRICES

BY

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A YEAR ago in an article* which was the fourth of a series, more or less annual, the writer brought the history of the American Government's intervention in the cotton market down to February, 1937, with the phrase: "It seems desirable, therefore, to wind up the whole history (for the time being at least) . . . and to consider the effect of the whole business of American Government action on the world's cotton supplies and consumption as a whole, and on cotton prices." Since then, however, what seemed to be the last chapter of the history has given place to the beginning of a second volume, and as the result of unexpected new developments, both in regard to crop control and to finance, the American Government now finds itself the holder of a larger amount of cotton than ever, with the prospect of a new era of crop restriction which is likely to last at least as long as its predecessor.

Perhaps the best way to bring out the dramatic character of the change which has come over things in the last twelve months is by a comparison of prices. In March, 1937, the current contract in New York went out at 14·85 cents, while July futures in Liverpool touched 7·99d. In October and November January futures in New York touched 7·50 cents, while Liverpool was down to 4·32d., though prices since then have shown a fair recovery. In March the index number of 419 stocks quoted on the New York Stock Exchange touched a figure of 132·4 per cent. on 1926, and on November 24 the corresponding figure was 75·6 per cent. The similarity of these declines is very significant.

The first point obviously is to recall the causes of the peak of prices in March, 1937, and that carries us quite a long way back. It is now generally accepted that the policy of cheap money which was inaugurated by this country in June, 1932, just after the Lausanne Agreement and the establishment of the Exchange Equalization Fund, was the beginning of the end of the great fall of world prices which had followed the Wall Street crash of October,

* "American Cotton Restriction and its Effect on Outside Growths," vol. xiv., p. 110, April, 1937.

1929. In America the rise of prices was of course intensified by their going off the gold standard in the spring of 1933, and the further developments of the U.S. gold and silver policies carried cotton prices up to a new high level in August, 1934. In 1934-35, in spite of a small crop due to drought on top of restriction, cotton prices sagged and continued fairly low during 1935-36, and it seems pretty clear now that this was due mainly to the competition of Outside Growths, which had received a tremendous stimulus from the restriction of the American supply. During these years, however, the general level of wholesale prices in this country, as shown by the Board of Trade Index Number, maintained their upward trend, and in the latter part of 1936 this became very marked. There is little doubt, however, that what finally sent prices soaring was the world-wide wave of rearmament which reached its crest in the dramatic announcement by the British Government in February, 1937, of a £1,500 million rearmament programme, of which £400 millions were to be raised by loan. This started a tremendous outburst of speculative activity in many markets, with copper and rubber showing the most dramatic rises, but it also carried cotton in March to the highest levels since June, 1930, as already described.

To trace the causes of the reaction in the general level of prices apart from cotton is not quite so easy. It probably began in America with a pronouncement by the President against the high prices of structural materials which was threatening to check much needed capital expenditure in industry. The U.S. authorities had for some time been uneasy about the development of their financial position owing to their heavy imports of gold, which were believed to be the result of the movement of "hot money" to America, attracted by the speculative boom. The authorities at Washington had already taken two steps to check possible inflation by increasing the minimum reserves to be held by the Federated Reserve Banks and by the so-called sterilizing policy with regard to gold imports. This merely meant that instead of allowing the Federal Reserve Banks to take up the imported gold, thus adding to their reserves, the Treasury would take over the gold themselves and pay for it with borrowed money, on the same lines as our E.E.F. had been doing all along.* But the spark which caused a most unexpected conflagration was the fact of heavy gold exports from Russia to America, which in April mysteriously started a rumour in New York that America might have to lower the price of gold. This started

* This policy was partially reversed in February, 1938.

the great "Gold Scare," which proved to be the breaking-point of the boom and started a headlong decline of prices which continued till October.

As there seems to be a good deal of popular misunderstanding with regard to the effect of lowering the gold price, it is desirable to explain in very simple terms just how it works. The trouble arises from the distinction between the *price* of gold and the *value* of gold. The value of gold is its purchasing power, and when that falls it is because prices have risen. But the price of gold is a very different thing. It merely means the amount of gold put into the standard coin which is the basic unit of the currency. Thus the old standard price of gold in America was $20.67 per ounce, which meant that an ounce of fine gold was coined into 20·67 dollars. But when the price of gold was raised in 1934 to $35.00 per ounce, that meant that an ounce was made into 35 dollars, so that there was less gold in each dollar, and the value of the dollar and therefore its purchasing power was reduced. That meant that prices rose because, each dollar being worth less, the owners of commodities expected to get more dollars, say, for a bale of cotton. That is why devaluation raises prices.

Conversely, therefore, to lower the price of gold again, say to $30.00 per ounce, would mean that only 30 dollars would be made out of an ounce of fine gold instead of 35—*i.e.*, there would be more gold in each dollar, and the dollar being therefore worth more, the owners of commodities would get fewer dollars for their commodity. In other words prices would fall. "Revaluation," therefore, as the lowering of the price of gold may be called, would mean deflation or a fall of prices.

The market very quickly realized this, and the mere suggestion of a lower price for gold at once produced a sharp decline in prices, which greatly alarmed the Government and compelled them to adopt every possible measure to reassure the market that it had no intention whatever of altering the price of gold again. As under the Tripartite Agreement of September, 1936, the price of gold was now practically a matter of international agreement, the British Government also did their best to reassure the world; and, as a matter of fact, it was probably their announcement in June, 1937, that they were adding £200 millions to our Exchange Equalization Fund, bringing the total up to £575 millions, which gave the gold scare its final quietus.

But the fact which had started the whole business remained unchanged—namely, the enormous increase of the world's gold

production since 1931, largely as the result of the increase in Russia's production. Figures of over 35 million fine ounces in 1936, of which Russia's share was 7,350,000,* were compared with 19,763,000 in 1929, including Russia 1,085,000; and all through the summer controversy was raging over the dangers that faced the world as the result of an excessive gold supply. In April America was practically the only country that was buying gold in unlimited quantities at a fixed price, but the mere hint of difficulties in sending the Russian gold to America produced a convulsion in the London Bullion Market and a rush to "dehoard" gold by those who had for many months been hoarding it as the one commodity of which the price was not likely to go down. The result was that our Exchange Equalization Fund had to come to the rescue and buy large quantities of gold, incidentally at very heavy discounts on the American dollar parity price.

One curious repercussion of the gold scare was its effect on the financial position in France. From September, 1931, when we went off the gold standard, the franc had been worth about 75 to the pound, instead of the 1928 figure of 124.21, the difference in effect representing the depreciation of the pound. But in September, 1936, France, with the remaining countries of the gold bloc, had to give up the struggle to maintain the gold standard at the 1928 figure, and reduced the gold content of the franc from 65·5 milligrammes of gold nine-tenths fine to somewhere between 49 and 43, the exact figure not being fixed until it was possible to determine at what point the franc would ultimately find its level. The result was that the franc fell to about 105 to the pound, about halfway between the 49 and 43 milligrammes. But by the spring of 1937 the French financial authorities were finding it increasingly difficult to keep it at that level, and during the storm over the gold scare they quietly let the franc slide to something over 110, which was near the lower limit of 43 milligrammes. Even that, however, did not save the situation, and in June, 1937, a political crisis in France resulted in M. Blum being replaced by M. Chautemps, and a new Finance Minister announced the abrogation of the 49-43 standard without its being replaced by any new limit. The result was that the franc promptly fell to 135.

On top of the gold scare London had its own troubles in the very unfavourable reception accorded by the City to the first version of Mr. Chamberlain's National Defence Contribution, but that also

* The high figures of the Russian production are now questioned, but they are still increasing for 1937.

passed over very quickly, for Mr. Chamberlain's first action as Prime Minister was to jettison the original scheme and introduce something much simpler, though it was in his view likely to be quite as productive of revenue. This is mentioned here because of the similarity of the controversy to others which broke out later in America.

Thus at the end of June, 1937, things had apparently quieted down again, but already a new cloud was beginning to appear on the horizon affecting cotton particularly. The July figures of acreage planted in America proved to be just about as expected with a 10 per cent. increase, but by that time it was becoming clear that weather conditions throughout the planting and early growing season had been unusually favourable; and with the first Bureau Report on August 8 there began a series of huge crop figures based on a yield per acre which was unprecedented in modern history. The result was a crop estimate of 18,746,000 bales in December, which beat all records. Coming on top of the already declining tendency of prices of commodities in general, this of course produced a further drastic fall in cotton prices. There was nothing in the conditions of supply in other countries to set off the huge yield in America, for the Egyptian crop soon followed with another record production and, as will be seen from our table of the World's Cotton Crops in the January issue, many of the other principal crops are also showing new record figures.

But the particular causes affecting cotton soon gave place again to another general movement affecting all commodities, which began with a new break on the New York Stock Exchange in September. The causes of this new decline were difficult to trace because it was not at first due to any reduction of industrial activity or the earnings of industrial companies, and the opinion soon began to grow that it was at least partly due to a concerted determination on the part of Big Business in America to show that the various measures recently adopted by the President in conformity with the ideas of the New Deal were crippling the whole business organization of America, especially the stock exchanges, the idea being to force his hand to some modification of these measures. There is no denying that the list of these reforms looked rather alarming. There was first the repeated raising of the statutory requirements for the reserves held by the banks. Then came the imposition of stringent margin requirements on the stock exchanges, followed by new taxation which was regarded as almost penal, including the Capital Gains tax, the Act to deal with certain loopholes in existing

taxation and the Undistributed Profits tax. Whatever the cause, there was no question of the fact that the flotation of new industrial capital issues on the American stock exchanges had practically come to a standstill, while the attempts of the administration to reduce Government expenditure on relief and public works of all kinds had inevitably a deflationary effect.

All this quickly produced a feeling of uncertainty as to the trend of industrial activity in America. The first indication was a decline in steel production, which it was believed was at first due to temporary or adventitious causes; but the decline soon gathered momentum, and, spreading to many other indices of business activity it produced the really alarming collapse of stock exchange values which was noted in our opening paragraph. The London stock markets were of course sympathetically affected, and the slump rapidly affected all the world's chief financial centres, including particularly France, where the sudden loss of confidence in America resulted in the largest repatriation of French capital invested there that has taken place since September, 1936. Roosevelt and the authorities in Washington have of course made many efforts to stem the psychological wave of talk about the "business recession" and the dangers of its leading to a permanent slump, for such talk has a dangerous habit of justifying itself; but all that can be said so far is that the decline has been checked since November. In this country signs of actual decline are not clear or serious, though the rise of unemployment statistics, which is much worse in America, is ominous.

In the meantime the American authorities had of course very quickly been forced to take action with regard to the immediate problem of the huge cotton crop. At the end of August the first announcement appeared of a new crop loan up to 9 cents per lb. along with a promised subsidy limited to 3 cents per lb. to all those who fell in line with the Government's new restriction policy which was promised to be ready in time for 1938. With the decline of prices far below the 9 cents level, the amount of cotton already placed under the loan has of course risen far beyond what the Government intended. The latest figures show a total of 5,084,000 bales up to 10th March which, with an amount of about 1,640,000 bales still remaining in the spring of 1937 from the loans of previous seasons, is obviously going to bring the total held by the Government up to nearly 7,000,000 bales, against the previous record of over 6 millions in 1935. The loan closes on 31st March.

All winter Congress had been very busy trying to hammer out the terms of the crop restriction proposals for 1938 and subsequent

years, for Roosevelt made it a condition of the loan that a restriction scheme must be immediately introduced; but a special session of Congress called for the purpose failed to produce a scheme, and in the ordinary session beginning in January the Senate and the House of Representatives produced two entirely different Farm Bills, which, following the usual procedure, were sent to a conference of the two houses. In this conference both Bills were largely modified, and the final result went back to the two houses of Congress on February 8.

They, however, passed it with astonishing celerity and apparently without amendment and it was signed by the President on February 16. The new measure certainly has " teeth in it." It is founded on the idea of a " normal supply " (ten years' average domestic consumption and exports plus 40 per cent. for carryover), and if the prospective Total Supply (actual carryover plus estimated crop) for any season exceeds this normal supply a " national allotment " or permissible crop for the next season is fixed by deducting the prospective carryover from the normal supply. For 1938 the national allotment aims at a crop of about 10,750,000 bales based on an area of 26,384,000 acres planted. That indicates an average yield of about 200 lbs. per acre harvested, but last year's yield of 264·6 lbs. would mean a crop of 14 million bales.

The national allotment is then to be parcelled out among all the growers according to their " farm acreage allotments " under the Soil Conservation Act on the basis of the previous five years' average yield. If the total supply exceeds the normal supply by more than 7 per cent. a referendum of the planters must be taken, and if a two-thirds majority approves, " marketing quotas " are applied under which penalties of two to three cents per lb. are imposed on any crop produced on acreage in excess of the allotment. This referendum is to be taken on March 12.

For compliance with the restriction the growers receive substantial payments under the Soil Conservation Act. There are also new provisions as to the extension of the 1937 loans till 1939 and for further loans in future years if conditions of supply and prices reach certain limits.

In the meantime the financial situation in France had again taken another turn for the worse. In January the Government's financial difficulties provided the opportunity for a bear raid against the franc which brought down the Chautemps Government, only to be replaced by a new Government under the same head, but with a new Finance Minister and with the extreme Left sections of the Popular Front party dropped out of the new Cabinet. The only

material result was that the franc went to 155, but in spite of all these strains and stresses the Tripartite Agreement still holds, though it is far from certain whether even yet the franc has found its ultimate level.*

Is it possible out of all this to form any sort of conclusion as to the prospects of cotton in the near future? It may be hoped that the decline in the prices of commodities in general has been checked, though on that point much depends on whether the feud between the President and Big Business has reached its last stage and whether confidence will return in America. As regards cotton, however, the position turns mainly on the question of how far crop restriction will be carried in the next few years and what the Government will do with their "Ever-normal granary" of say 7 million bales of cotton. If they are prepared to hold it more or less permanently this season's unprecedented world supply may not prove to be so very burdensome after all, but previous experience of Government holdings has shown that their worst effect on the market was due to uncertainty whether, when, how much and at what price the Government would sell. At present there seems to be little ground for hope that we shall escape another period of similar uncertainty in the next few years.†

The other uncertainty is what effect a price of say 7½ to 9½ cents for American cotton will have on the production of Outside Growths in 1938.

* Another political crisis in France in March brought M. Blum back to power again, and combined with the dramatic developments in Austria carried the franc down to 167½.

† The new Act limits sales after 31st July, 1939, to 300,000 bales per month and 1,500,000 bales in any one year. The referendum gave an overwhelming majority in favour of marketing quotas.

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A NOTE ON THE TECHNIQUE OF COTTON BREEDING

BY

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Some twelve to seventeen years ago the writer was working on cotton breeding in the West Indies and later in West Africa. On a recent visit to India he had occasion to visit a number of places where cotton breeding was in progress, and he was forcibly struck by the fact that the methods at present in use are essentially similar to those used more than a decade ago. In spite of the enormous progress made by the science of genetics the practice of cotton breeding remains an art. As Dunn remarks in his book "Heredity and Variation," "The discovery of Mendel's laws and of the mechanism of heredity was widely heralded as presaging a millennium in agriculture by revolutionizing the breeding of animals and plants. It is plain that this has not yet occurred and the application of the new methods will require a long time."

When one recollects the enormous complexity of the factors that make for yield and the inability of the physiologist as yet to characterize even the more obvious of these factors, it is not surprising that the plant breeder still adheres to empirical methods in his attempts to improve the yield of cotton. The position with regard to the commercial lint characters is not a great deal clearer, for the spinner is still unable to specify exactly what he wants. Even the genetics of such a relatively easily measurable character as lint length has not yet been fully elucidated.

Though it may not be surprising that the impact of the science of genetics on the practice of cotton breeding has been so small, it is surely remarkable that the age-long art of hybridization as a means of synthesizing commercially satisfactory strains has been so ineffective. Other crops have benefited considerably by this method, though it is perhaps true that the more conspicuous successes

have been with vegetatively propagated plants like sugar-cane. The technique of back-crossing, which Harland has developed as a means of retaining desirable characters after hybridization, is, however, full of promise. Already a great deal of progress in the development of superior strains of cotton has been accomplished by this means, but so far as the writer knows none of these strains has yet passed the acid test and entered into commercial production.

It will probably be admitted that the bed-rock of cotton improvement is still the time-honoured practice of selection. Plants that are judged to be of outstanding merit are selected in the field. The progeny of each of these *primary* selections are grown in one or more progeny rows, where they are selfed. *Secondary* selection of plants within the progeny rows may continue for several generations until a strain is evolved which is considered to warrant testing out in a variety trial. The value of a selection is judged in terms of its progeny. The greater part of the time is spent in secondary or re-selection. The danger in re-selection lies in the fact that while certain desirable characters are being improved others equally important are liable to be lost. Hutchinson and Kubersingh have published a valuable analysis of the efficiency of the selection methods used in the improvement of Malvi cotton, and have concluded that "the changes ascribable to selection have been disappointingly small," and that whatever success has been achieved "is ascribable primarily to the breeder's judgment and not to the selection methods."

The great difficulty experienced is usually in judging the yielding capacity of a strain from a small number of plants. The yield of an individual plant is so greatly influenced by environmental heterogeneity that considerable weight is given to such characters as seed-weight, lint-index, weight of lint per boll, etc., which are usually correlated with yield, but which are less affected by the environment. A great deal of time is necessarily spent in making these measurements and also, of course, in the examination of the lint characters. The number of primary selections made is usually small and the time spent in making these selections occupies but a small fraction of the total time of the cotton breeder and his staff. It is possibly true that much of the time at present spent on re-selection is due to the erroneous belief that homozygosity is always essential before a strain is recommended for commercial production.

When one comes to examine the history of the commercially

successful strains of cotton, one usually finds that about 80 per cent. of their success depends on the initial or primary selection. Little improvement in yield is usually accomplished by continued secondary selection, though the lint characters and ginning percentage are often appreciably advanced in this way. The genesis of a great commercial cotton has so often been due to a lucky find, very often by someone not primarily concerned with cotton breeding, that one wonders whether a greater amount of time and attention should not be devoted to primary selection and less to secondary selection.

If the breeder decides greatly to increase the number of primary selections, he is confronted by a number of difficulties. In the first place, unless his staff is augmented, he will have to reduce the time spent on secondary selection. It might even be advantageous to eliminate secondary selection completely and to plant the progenies of the primary selections in the form of Harland's Dotted Yield test or Hutchinson and Panse's Replicated Progeny Row method. By one of these means a much better estimate of the yielding capacity of his selections might be obtained by the breeder than is possible in the usual progeny row method. The strains that graduate could either be multiplied with a view to a full variety test or in special cases might undergo a period of re-selection. The acreage at his disposal will also have to be greatly increased.

The full advantage of an increase in the number of primary selections will not be obtained unless it is possible to increase the genetic variability of the material. The most obvious way of doing this is to introduce varieties from other countries. Very often (*e.g.*, in Northern Nigeria and the Punjab) such introductions compare poorly with the local varieties and commonly they are scrapped after a few generations. The writer believes that the full importance of acclimatization is not always appreciated. Acclimatization appears to be of great importance in cotton and might be accepted as a fact even though the mechanism involved is not at present known. In passing it may be remarked that the evidence available does not appear to warrant the dismissal of functional heredity as a factor in this process. The value of an imported strain may not be apparent until it has been acclimatized, and this may take a number of years. It is becoming more and more realized that each locality must breed its own cotton. It is a remarkable fact that new introductions sometimes show great fluctuations in yield from year to year until they become acclimatized. Thus in the Punjab the fluctuations in yield are now growing less

and the same seems to be true of the Sudan. In Sind, where Egyptian cotton has recently been introduced, the inter-year fluctuations are enormous. With patience and the selection of suitable sites the prospects of establishing an Egyptian cotton industry in Sind are, the writer believes, good. It is remarkable how a cotton that is highly resistant to some pest in one country may be quite useless when it is grown elsewhere. Thus the highly resistant U.4 of South Africa is rather susceptible to jassids in the Punjab.

Other means of increasing the genetic variability of his material will readily occur to the breeder. For instance, it would be possible, for any particular type of cotton, to build up a complex hybrid which would serve as an omnibus for the genes of the more important varieties of all the countries growing this type of cotton. This complex hybrid could be planted out for ten or a dozen years or until such time as its progeny had become acclimatized. The importance of such a welter of types from which primary selections could be made has often been stressed, but seemingly it is seldom utilized. It might even be worth while to send seed of the local type of cotton to a number of other cotton-growing countries where it could be grown for one or two generations and, of course, would be selfed. On its return it is possible that it would exhibit greater genetic variability and would provide new opportunities for selection.

If a large number of primary selections are to be made each year, it will be necessary to organize some sort of staff. The difficulty will lie in training them. People are born with this type of aptitude and not made. In countries where cultivation is primitive and conditions exacting, it would be an error to make selections and to test their yielding capacity under conditions of good cultivation and high fertility. It may be a useful concept to select for resistance to low-yielding capacity in the same way that selection for resistance against disease is made. In selecting, for instance, a plant resistant to leaf-curl, selection would only be made in areas where the disease is prevalent, similarly in selecting against low-yielding capacity, selection should only be made in places where the majority of plants are yielding poorly. The analogy is admittedly far from perfect, for the conditions that make for environmental heterogeneity in the two cases are not quite parallel. It will probably be better to make more selections in bad crop years than in good crop years.

In some places the commercial crop consists of a great variety of types. Where soil heterogeneity is considerable and where the

weather conditions fluctuate from year to year, this affords some measure of insurance against crop failure. Anything approaching a pure line is here obviously at a disadvantage. In other places the same object is achieved by growing cotton in mixed cultivation. In this case the selector would not make his selections from pure stands of cotton, for such cotton might be unable to compete with other crops. In Southern Nigeria long-continued attempts were made to introduce American cotton. The failure of these attempts was conditioned partly by the inability of this type of cotton to compete successfully with other crops and partly by its susceptibility to stainer and boll-worms. One of the most interesting mixtures of cotton that the writer has come across is that found in Central India where American and Indian cottons are grown side by side. There is probably something beyond the insurance factor in this case, for the American is said to be benefited in some way by the Indian cotton; alone it does not seem to do as well. Whether the hybrid-vigour factor (whatever it may be!) militates against the pure line has also to be taken into consideration. The breeder will have to find out for each locality whether or no a pure line is desirable or whether he would do better with a mixture of types. Before coming to a decision he will, of course, have to consider both the yield and the commercial lint characters.

One factor in acclimatization may well be an increase in genetic variability, another, of course, may be an increase in genic plasticity; both factors may lead to a reduction in the fluctuations in yield that occur from one year to another. In places where the climatic and soil heterogeneity tend to be damped by cultivation, manuring and irrigation, it will probably be found that the advantage of mixed types is diminished. In general, it might be expected that a mixture of strains would be suitable for a wider area than a pure strain. The writer closes this note with a quotation from a paper by Hutchinson, Panse, Apte and Pugh: "The crop analysis data on both jowar and cotton, and general observations in other crops, show that the equilibrium condition between crop variability and combined human and natural selective forces is a balanced mixture, and not a pure type. In other words, the survival of the fittest is of the fittest population and not the fittest type, and the fittest population is a mixture of types."

In conclusion, the writer has pleasure in acknowledging his indebtedness to Professor F. L. Engledow, C.M.G., and to Mr. J. B. Hutchinson for their valuable criticisms and suggestions.

NOTE ON DR. MASON'S ARTICLE ON THE TECHNIQUE OF COTTON BREEDING

BY

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I suspect that this article was written partly with the object of inviting discussion on certain statements that have been made which would appear at first sight to be of a controversial nature. If this is the case, it may serve a useful purpose because I believe that the time has arrived when careful analysis of the results obtained by cotton breeders in the British Empire within the last fifteen or twenty years cannot but do good. Dr. Mason draws attention to the practice of secondary selection within progeny rows, and points out that the results are often disappointingly small, and that during the process, although some valuable character may be improved, others may be lost. While it is true that the primary selection is all important, it is doubtful whether the necessity for secondary selection can be so lightly dismissed in the case of long-staple cottons such as Sea Island and Egyptians. The need may not be so obvious in the case of ordinary " bread and butter " cottons, where a high degree of homozygosity may not be so essential. To my mind the capability of making the preliminary selection in the field is the all-important one. This faculty is, I believe, partly instinctive. It is necessary that the breeder should be thoroughly acquainted with the crop, growing in bulk, as only then can thorough familiarity with the various factors that go towards the " make up " of a desirable cotton plant be obtained and the necessary correlation made. It is for this reason therefore that a budding cotton breeder should be made to serve in a real cotton-growing country for his apprenticeship, and that a cotton-breeding station should be located in an area in which cotton is being produced as a commercial crop on a large scale.

The possibility of increasing the genetic variability of the material for selection is referred to, and the introduction of varieties from other countries suggested. This, of course, is the system that has been adopted by Agricultural Departments for years past. In the case of certain types of American Uplands the " shake up " resulting from such a transfer from one country to another is often amazing. In Queensland, for example, seed from a pure line of the well-known

variety Webber 49 received direct from a research station in the States came true to type in the first generation but showed an immense variation in the second generation. The same thing happened with the variety known as Durango, and it is safe to say that the type now grown as Durango in Queensland, which was the result of a selection made subsequent to this "shake up," bears very distinct differences from the Durango as originally grown in the Southern States. This phenomenon is sometimes known in the States as "new place effect," and another instance that one recalls to mind is the so-called Mesowhite in Mesopotamia which was developed again from Webber 49, and which was first planted in Iraq about 1918. Similarly, Cambodia cotton showed "new place effect" very markedly in Queensland, and also in Bengal. Some cottons, such as Allen's Long Staple it is said, do not show it, and would appear to be much more stable. If this is a fact, then it provides a reason why comparatively little progress has so far been made in developing types of Upland cotton that are really suited to the climatic conditions of Nigeria.

Dr. Mason's remarks about the necessity for acclimatization are not quite so easy to follow. So far as the Punjab is concerned, the American Upland type cotton 4F was selected at least twenty-five years ago in the Punjab. I am not clear whether it was selected from one of the Dharwar (Bombay) Uplands or from one of the Punjab Uplands. If the latter, the cotton must have been growing in the Punjab for well over 100 years, as these Upland cottons were introduced by the old John Company. If the selection was made from the Dharwar cottons, while admitting the great difference in climate and environment between Bombay and the Punjab, it has nevertheless had at least twenty-five years in which to acclimatize itself in the latter province.

The question of mixing crops as an insurance against total yield failure is a common practice in regions which have to depend on an unreliable rainfall. An extreme case, of course, is in the Chittagong Hill Tracts of Eastern India where the Comilla cotton is grown as a mixture with hill rice. If the monsoon is light, the cotton does well; if heavy, the rice scores. Applying this practice to cotton, Dr. Mason quotes the interesting case of a mixture of Upland and Indian cottons growing in Central India. This practice also occurred in parts of the Central Provinces before the War and now appears to be on the increase. If the monsoon were light and terminated early the Indian cotton yielded well, but the Uplands, which were later in fruiting, suffered from "red leaf" and other troubles which

may have been partly caused by thrips, but were probably also due to drought, since these black cotton soils crack badly as soon as the monsoon is over.

This variability in the monsoon is a factor that has to be contended with, and the idea that a crop may be ensured by the growing of a mixture of types is interesting. In certain districts of the Central Provinces and Berar, such as Nimar, which grow cottons of the *neglectum* type, years of light but well distributed rainfall often give the best yields. One of the best crops seen was with a total monsoon rainfall of only nineteen inches. The possibility of breeding types with slightly different ripening periods and of sowing this mixture as an assurance against the vagaries of the monsoon is an interesting one.

The suggestion is also made that in the mixture of American and Indian cotton, the American is benefited in some way by the Indian, but the result of definite experimental evidence on this point will be awaited. The fact that a mixture of such diverse types as American Upland and Indian cotton can be grown and ginned together and purchased and accepted as a regular commercial cotton must come as rather a shock to the plant breeder in other countries, who has been led to assume that the variety should be as uniform as possible in regard to staple and lint character. So far as short staple cottons of one inch or less are concerned this would appear to be the case, but it is presumed it will not apply to long-staple cottons. The point will no doubt also prove of interest to the technologist.

It is possible that cotton-growing interests in Great Britain have in the past been too wedded to the introduction into the colonies of cottons of the American Upland type. For thirty years or more attempts have been made to establish cotton of this type into areas which are probably not really suited to it; the outstanding success is Uganda, but the failures have been numerous in other parts of the Empire. A vast amount of time and attention has been devoted to these Upland types, and one wonders what would have happened if a little of this time and money had been spent on exploring the possibilities of other types such as the Asiatics or the perennials. It is possible that more progress might have been made towards establishing permanent cotton-growing industries, particularly in those countries possessing an unreliable rainfall.

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THE USE OF FILMS IN AFRICAN AGRICULTURE

BY

G. C. LATHAM.

Few people in these days will deny the great potential value of the film as an aid to education and as a means of propaganda. So far, however, little effort has been made by African Governments to add this powerful weapon to their armoury. This is all the more remarkable since genuine interest is now being taken in African education and development, and the appropriations of revenue for these purposes increase yearly.

The reasons for this apathy are probably twofold. In the first place, though Directors of Agriculture, Medical Services, and other departments are often fully alive to the value of films, especially for propaganda purposes, and have in some cases made and used their own films, Secretariats and Treasuries have yet to be convinced that the benefits would justify any considerable expenditure. Secondly, until recently there has been no attempt to work out a practical scheme for supplying Governments with the films they require at a reasonable cost. The result has been that projectors have not been forthcoming because there was an insufficient supply of suitable films to show with them, and no company has been prepared to make special films for the purposes required because there was not an adequate market for them.

This vicious circle should be broken without delay. A practical scheme for doing so is given in "The African and the Cinema," which is an account of the recently ended Bantu Educational Cinema Experiment. Whether the scheme there outlined is adopted or some better one is forthcoming, it is to be hoped that Governments will soon become more alive to their opportunities.

The only organized attempt in the Empire to use films over a period of years for agricultural propaganda on any considerable scale seems to be that of British Malaya, and the experience gained is relevant to our problem. The enterprise, in operation now for seven years, is run jointly by the Co-operative Societies Department, the Department of Agriculture and the Rubber Research Institute. Interesting accounts are given in the *Malayan Agricultural Journal* of November, 1936, and in an article by Mr. Gerald Hawkins in the July, 1937, number of *Overseas Education*. Mention will be made

here only of those features which seem to have an immediate bearing on the problem for Africa.

A rural lecture caravan with cinema and lantern slides is used. The chassis is a 1½-ton Morris; the body was built locally. Sleeping berths are provided for the driver and operator. At first a trailer was attached to carry exhibits, photographs and models for demonstration purposes, but later this was discarded and the contents were placed in space made vacant under the sleeping berths. The original method of driving a dynamo by means of a belt passing over the outside of the tyre of one of the wheels raised by a jack was discarded in favour of a 2½ h.p. Blackstone engine, recently replaced by a 5 h.p. National engine which has proved more satisfactory. The engine and dynamo provide the power for cinema and amplifier. When loaded with lighting set, etc., ready for the road the weights of the caravan are: front axle 18½ cwt., rear axle 2¾ tons. It has travelled over 30,000 miles in seven years.

"The tour programme is prepared at bi-monthly meetings of an informal committee for propaganda and marketing, consisting of representatives of the Rubber Research Institute and the Agricultural and Co-operative Societies Departments. Villages are given due notice of the arrival of the caravan by posters and preliminary talks from the junior field officers of the departments.

"A log book is so kept as to be a complete record of the caravan. From this log book can be deduced the type of instruction that obtains the best reception in the various areas. The caravan spends two days in each village giving lectures and demonstrations in the afternoon and films and lantern-slide lectures in the evening. The films shown and demonstrations given in each area are selected as those most suitable to the needs of the local populace."

The films used are all locally composed, shot and developed, except for an occasional amusing "short" to lighten the programme. Endless trouble is taken to get the details absolutely true to the local background. Mr. Hawkins records that "the films do much good. The lessons propagated by the caravan are directed to the purpose of better production and better marketing, with the elimination of waste and inefficiency. The caravan is invariably well received, and a repeat performance is always demanded."

Some use has been made of films in South Africa for agricultural development, and in India and elsewhere attempts have been made to use the cinema and such films as are available for propaganda for rural reconstruction, but the production of special local films for these purposes is essential if they are to have any real influence on

local opinion and practice, and it is this regular production of special films which requires organization.

The Bantu Educational Cinema Experiment, of which the writer was educational director, and which was operating in East Africa for two years from the middle of 1935, was experimenting with the economical production of the type of films required for more or less primitive and illiterate audiences, and with economical methods of displaying them. All the films were 16 mm.

Many films were made in close co-operation with the officers of the Agricultural and Veterinary Departments, and some account of them may be of interest. The subjects, "Soil Erosion" and "Peasant Holdings," were dealt with early. The later films included one on "Improved Agriculture," 1,000 feet; three of 200 feet on "The Growing and Marketing of Coffee"; "Msukuma Farmer," 600 feet; "Farm Implements," 400 feet; "Agricultural Education at Bukalasa, Uganda," 1,600 feet; and "Marketing of Export Native Maize," 600 feet. All of these except "Farm Implements" had commentary on disc in the local languages.

The films "Improved Agriculture" and "Msukuma Farmer," both made in Tanganyika, and "Agricultural Education at Bukalasa," made in Uganda, all illustrate methods advocated by the Agricultural Departments with special reference to local conditions. The first deals almost entirely with the growing of maize, but the main points illustrated—seed selection, crop rotation and manuring—apply to other crops. "Msukuma Farmer" shows methods taught at the Government Experimental Station near Mwanza, and is presented as a visit to what is actually a demonstration small-holding. The commentator questions the small-holder on behalf of the audience. Ploughing, ridging, cultivating, and manuring are shown. The last part of the film shows the small-holder demonstrating the economics of his holding and explaining the system of crop rotation adopted. We used the same method for this purpose in other films. The owner draws a simple plan of his farm on the ground and divides it up into plots. He then puts seeds of the various crops—maize, millet, groundnuts, cotton and cassava—on the different plots. Later, when the crops have been gathered, pegs with cards showing the amount realized for the cash crops are shown; the seeds are then removed and the seeds of the crop to be planted next on that plot are transferred to it. The whole process is explained in the accompanying commentary. An agricultural officer in Uganda describes this as "the best method of demonstrating rotation I have yet seen."

The specific purpose of the Bukalasa film is to demonstrate the agricultural methods recommended there for the Buganda Province. In particular it is to support the work of teachers and instructors who have attended the course at Bukalasa. The action takes place slowly in order that it may be definitely instructional. There are two sequences which illustrate the special function which the cinema can perform: one is the explanation of crop rotation on the lines described above; the second is the scene supposed to take place in the office of a Liverpool broker, the purpose of which is to warn cotton growers that Uganda cotton may be de-graded unless more effort is made to keep it clean.

To turn to the question of exhibition. The display unit used by us consisted originally of a 2-ton lorry with a trailer on which was mounted our engine and dynamo. We discarded the trailer after the first tour of nearly 6,000 miles, and substituted a box body car to carry the personal kit of the two Europeans. We did not have sleeping berths on the lorry, but took tents and full camp equipment. Our cinema equipment consisted of a Bolex projector and a flexible drive coupling it to a turntable, a 10-watt amplifier, two powerful horn-type loud-speakers, and an engine and generator which supplied current for the projector and for the amplifier separately.

Nearly all the displays were given in the open. After selection of the site the 10 by 8 foot screen was set up and the lorry put into position broadside on 63 feet away from it. The projector box was put on a board across the sides of the lorry, and the operator, with his native assistant to work the gramophone, sat in the lorry. The engine was put about 50 yards away, behind a tree or building, if possible, to deaden the sound. The loud-speakers were placed on either side of the screen. With this large unit we showed on occasions to audiences of more than 3,000 natives.

We now come to our main problem: How can the cinema be most profitably used in Africa for the improvement of native agriculture? The writer believes that its chief use will be to arouse interest in a subject as a preliminary to a more intensive campaign by means of lectures, demonstrations, lantern slides, gramophone records, radio, and other methods. The natives—including the women and children—who will not leave their villages to hear a lecture or attend a demonstration, will certainly go, possibly several times, to see a programme of films. Again, a moving picture, especially if it is in story form with explanatory comments in the local language to make it better understood, is much more likely than the spoken word to stir the emotions of the audience and to cause subsequent

discussion in the villages. Once interest is aroused, other educational methods will have a much greater chance of making an impression. If, for instance, a campaign against soil erosion is being instituted in any territory, the procedure might be on the following lines. Any cinema units established in the neighbourhood at schools, missions, Native Administration headquarters, or other centres should be supplied with a film on soil erosion, which should preferably have been made locally, or should have a background easily recognizable by the local natives as applicable to their own conditions. It might have a story running through it, showing, perhaps, a prosperous tribe in occupation of well-timbered country, perennial streams, good crops and fat cattle; then the gradual deforestation of the district, the clearing of slopes and hill tops for cultivation, the drying up of streams in the dry season, the beginnings of sheet and gully erosion, shortage of land for gardens and pasture, starvation of man and beast, accentuation of the trouble by the overstocking of reduced pastures, the depredations of goats preventing regeneration of the forest, wind blowing away the uncovered and trampled top soil in the dry season, and rain storms carrying away what is left into gullies and rivers. Scenes of the reclamation of eroded land and of tribal co-operation in fighting the menace and saving their lands could then be shown.

A touring cinema would visit the villages not within reach of other cinema units. The exhibition of the film, which might with advantage be part of an entertaining programme, should be followed by a visit from a representative of the Agricultural Department. Lectures, demonstrations and visits to see anti-erosion methods would be organized during the day and lectures illustrated by lantern slides or further films given at night. For actual instruction and for illustrating lectures slides are often better than moving pictures, and more easily and more cheaply made and shown. It might be a good plan to make slides from still photographs taken during the making of films, as the connection between the two should help in maintaining the interest of both. There are many gramophones in the villages nowadays, and there are great possibilities for the use of records giving short talks or songs driving home points and ideas with which it is desired to familiarize the inhabitants.

Where there are large numbers of cinema units or projectors distributed throughout a territory films can be used more effectively, and with frequent repetition will be useful for imparting knowledge as well as for arousing interest. When the former is the main aim it will be desirable not to make the film too comprehensive. It will

be better to have a number of short reels of, say, 200 feet each concentrating on one of the factors that lead to erosion or help to check it.

The use of the moving picture in actual instruction in agricultural schools and training institutions is likely to be limited. Slides are cheaper and generally equally effective. The device for stopping films at any point, which is now on most school projectors, makes it possible, however, to use films for lecturing, and there are some subjects which films can illustrate in a unique way. An obvious example is the growth of a plant from seed.

Where Africans grow crops which are also grown in other parts of the world, like cotton, the film may be of value in showing in a graphic way the methods of cultivation, ginning, and marketing used in different countries, the effect of competition in world markets or the amount of handling which the crop has to go through before it reaches the Lancashire mills. Such pictures will help them to understand the reasons for price fluctuations, and they will be interested to see how their bales of cotton fare after leaving the growers.

Agricultural, Veterinary, and Medical Officers have remarked how valuable it would be to have talkie films which they could supply to their native instructors, thereby making certain that the commentary and explanations given were accurate.

Any scheme for the use of films will need modification according to the conditions prevailing. The character and the state of advancement of the inhabitants, transport facilities, the density of the population and other considerations will all have a bearing on the type of film and the type of equipment to be used. There are, however, certain principles which will apply to most African territories. In regard to the films it will generally be found—and the more primitive the population the truer this will be—that scrupulous accuracy in the portrayal of local custom, costume and ways of living will be essential. Any blunders in this respect will enable the all too willing native to dismiss the story with ridicule. What is true of the peasant of Malaya is true of the African tribesman. "Their ways are not our ways, and their standards are not our standards, and in an attempt to win the sympathetic and whole-hearted support of a peasant an offence to his susceptibilities or to his sense of the probabilities would rank as a major disaster. The sympathetic understanding and respect of a naturally shy and reserved rural population have to be obtained before its customs can be modified. Any departure from the normal is welcome to

none, and to get the most conservative portion of a conservative race to abandon ancient methods is a delicate task."

It follows from this that the films must be made where they are to be used. The writer has been assured by film experts in England that the films could for the most part be shot in studios in London much more cheaply and efficiently, and that only a few shots taken in Africa to give true local colour would be necessary. Few people who know Africa will agree with this. For entertainment films designed for western audiences it may be possible to fake scenes in studios, on reaches of the Thames, and elsewhere, which will deceive most Europeans. Even Africans, who would definitely not be deceived, might not care how the thing was done provided the story were sufficiently entertaining. For propaganda films, when one is trying to demonstrate to the African that he can do this or that in better ways because, as he sees in the picture, his fellow Africans have already done so successfully, any suspicion that the picture was faked in another country would be fatal.

If, then, the films have to be made on the spot, how can this be done with the maximum of efficiency and economy? It is possible, of course, for each Agricultural Department to have one of its own officers trained in the use of the cine-camera, to let him take the required films, and send the negatives to be processed by the trade. They would be silent films and no great technical merit could be expected, but they might serve their purpose. If films to be used by Governments were to be confined to those of an agricultural nature this might be the best solution, as it would certainly be economical. If, however, as we recommend, Governments use films on a considerable scale, not only for educational and propaganda purposes for several departments, but also to provide healthy recreation and amusement for their native populations, the advantages of some combined scheme such as is advocated in "The African and the Cinema" are overwhelming. Under this scheme each territory or group of territories would have its own producer and camera man, who would be filming for about eight months every year. There would be a central organization in London, supported by all territories participating, which would see to the preparation of scenarios, the provision of camera men, the training of producers with the necessary local knowledge, the processing and editing of all films, and the provision for each territory of suitable films from outside sources to fill up and increase the interest of programmes. One great advantage of a central organization would be that the same material could often, by various means, be made effective for

different territories, thus increasing the supply of films for any one. Also centralized large-scale buying would make for economy. The quality of films produced, photographed and edited by experts, in collaboration, of course, with the local departmental officials, would necessarily be superior.

There are many advantages in the sound film for illiterate audiences, but it is probable that owing to the lower cost and greater simplicity of projection and operation a start will usually be made with silent films.

A word in conclusion regarding displaying equipment. The cost of the portable unit supplied to the East African Governments to show our films with sound-on-disc was approximately £60 with an amplifier. This proved satisfactory for audiences of up to 100 persons. Twice this number could see the picture, but they could not hear the commentary. Since these units were handed over Major Notcutt, Field Director of the experiment, has been endeavouring to improve on them. He has designed a unit which, though estimated to cost only £80 complete with engine and all accessories, would be much more powerful. This unit has not yet been tried out. The point to be noted is that if finance is forthcoming for a renewed effort to use the 16 mm. film effectively in Africa and elsewhere on a considerable scale, there is no doubt that great improvements are possible in the apparatus at present available for exhibition, without any serious increase in the cost or in the difficulty of operation.

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SOME REMINISCENCES OF WORK ON THE COTTON CROP

BY

H. C. SAMPSON, C.I.E., F.L.S.

II

In India it is a much easier task to effect the improvement of an indigenous than of an exotic race of cotton. The former has been in cultivation in the same locality perhaps for centuries and has thus had ample time to adjust itself to the soil types and cultural conditions imposed on it by man. There is not, therefore, the same liability to fluctuations in the quality of the lint from one season to another. In my experience also the indigenous cottons are not nearly so liable to attacks of insects and diseases as are exotics. Bollworms, for example, which are such a handicap to cotton introduction in many of the new cotton areas of Africa, never cause any serious damage to indigenous cottons in Southern India. Whether this supports Howard's theory that because a plant is growing in a suitable environment it is not so liable to suffer, or whether it is that the Old World cottons have not the same attraction for the bollworms as have those of the New World, I do not know. The numerous and sustained efforts of the East India Company during the first half of last century to introduce New World cottons into India mostly ended in failure, mainly on account of excessive bollworm damage, and, even in the case of the successful introduction to Madras of Cambodia cotton in this century, bollworm damage is a constant menace, though it has been kept in check by rigidly enforced regulations regarding uprooting by a certain date.

The only pest which ever caused any serious loss was the cotton aphis, and this only in seasons of protracted drought. In only one respect was the local cotton more vulnerable than the exotic, and this is due to its deep root system. Anyone familiar with black cotton soils knows how these swell when they are thoroughly moistened. The result of this on the deep-rooted Indian cottons when in the full vigour of growth is disastrous. Root aeration is so reduced that the plant is suffocated, and this causes wholesale shedding of flowers and young bolls. Prolonged unseasonal rains

may even cause the shedding of the leaves as well. The difference between the root system of indigenous and exotic cottons is well exemplified in the area where Bourbon cotton is grown. This is a survival of one of the exotic cottons introduced in the eighteenth century in an attempt to improve the quality of the Indian cotton crop, and it still exists on the red soils bordering Coimbatore and Salem district. The Bourbon and an indigenous cotton known locally as Nadam are always sown mixed. It is a very precarious district with a rainfall of about 20 inches. If only light rains are received the Bourbon will flush, owing to its shallower root system, and may give a crop, while if heavy rains fall the deep-rooted Nadam will give a crop. Both are grown as perennials.

An indigenous cotton also has an advantage when it comes to the marketing of the crop. The buyer has an intimate knowledge of the local cotton which he is accustomed to buy, and sometimes he has mill experience to back up this knowledge. Any improvement in staple and handling is therefore at once noticeable. In the Tinnevelly cotton tract we were particularly fortunate in not only having up-to-date and well managed spinning mills adjacent to the cotton tract, but also in the fact that these mills had their own buying agency. It was owing to the good offices of their buying agent at Virudupatti and to the management of the mills that we were able to get reliable spinning tests carried out on the cottons produced from our new selections. These tests fully confirmed my own opinion of their value, and in time, as their growth expanded, a premium was established for cottons grown from our seed.

Having established the value of our selections both from a cropping and a spinning point of view, the next task was to increase the supply of seed. This could either be grown departmentally on areas which would have had temporarily to be leased, or it could be grown by farmers on contract terms. The latter method was adopted, as we neither had sufficient trained staff to attend to the growing of the crop, nor had we the money to finance such an undertaking. The method which we adopted had also the advantage that it could be expanded whenever necessary to meet any increased demand for seed.

In the Tinnevelly cotton tract this was probably more easy to arrange than in many other parts of India. The farming population on the black cotton soils are an immigrant race, being descended from the retainers of the Naik Poligars set up during the time of the Vijianagar Dynasty. Even to the present day, although

Tinnevelly is in the extreme south of the Tamil country, Telugu is still the house language of these farmers. Much of the feudal system still survives in the Zemindari areas of this region. The best collection of working bullocks which I ever saw was on the Ettayapuram Zemindari. The superintendent of the Rajah's home farm lands had called on all the tenants of the Zemindari to furnish a pair of bullocks and a plough on a certain day to plough the home farms. Each tenant had turned up with his best pair of bullocks all groomed and bedecked with ornaments for the day's ploughing, apparently regardless of the fact that each should be taking advantage of the sowing rain to sow his own lands. Having been settled in this country for only three or four hundred years, these people are probably not tied down to custom to the same degree as would be an indigenous race. They are excellent farmers, but have evidently only learnt their art since they came south, as they had no knowledge of the seed drill and implements of inter-cultivation which belong to the country from which they originally migrated. Thus all their crops were broadcast, and as far as cotton was concerned after-cultivation was entirely dependent on the hand hoe. The result was that frequently a full stand of cotton was not obtained, or could be obtained only by using a heavy seed rate, while in seasons of heavy rainfall inter-cultivation would get behindhand and was perforce often neglected.

One of the first things which Mr. Benson did when he opened this agricultural station was to introduce the indigenous seed drill and implements of cultivation from the northern Telugu districts. The successful use of these on the agricultural station was followed up by their equally successful introduction on privately owned lands in the adjoining villages. Thus the ground was, in a way, prepared for the development of contract seed farms where these methods of cultivation were made obligatory in the contract. Such an obligation was necessary in order to make the limited quantity of seed available go as far as possible consistent with a good stand.

Thus were the seed farms launched. So successful were these first efforts that in the following season there was no difficulty in establishing a much larger area of seed farm: in fact we were embarrassed by the offers of land for this purpose.

One of the conditions in our seed farm contract was that the previous crop grown on the land had to be Cambu (*Pennisetum typhoides*), which the work on the agricultural station had shown to be the best preceding crop for cotton. This is the main cereal of these black cotton soils, and in consequence it receives all the

available supplies of manure. We knew that the cotton crop should not be directly manured, because this tended to develop vegetative growth and to delay the ripening of the crop. This had to be avoided at all costs, because every day's delay in ripening meant that the weather was getting hotter, and, moreover, the sea breezes which were an important factor in the development of the crop would have died down with the advent of such hot weather. What we did not fully realize was the position which Cambu occupied in the economy of the local farmer. We knew that he was dependent on this for his existence and that it was the most important of his rotation crops for cotton, but what we did not appreciate was that as an insurance against failure of this crop he usually reserved a portion of his farm on which he grew Cambu year after year and on which he applied all his available manure. Such land was known as "Cambu adi," which literally means "beaten with Cambu."

In their anxiety to become contract growers of seed farms several farmers offered us a portion of their "Cambu adi," which we accepted. We inspected the lands, walking over the clean, ploughed ground, and noted the excellent texture of the soil compared to the usual run of such soils. What we had not taken into account were the large reserves of surface fertility which these lands had accumulated, in which the cotton roots would spread instead of going down deep and protecting the plant from drought. The seed farm crops looked splendid until the bolls should have been swelling, but their root system was not equipped to withstand the continued dry weather which ensued, and soon the plants began to flag and shed their bolls.

Both the farmers and we had learnt our lesson, and after that we no longer selected "Cambu adi" for our seed farm areas.

In spite of this setback, the popularity of our seed farms continued. Their supervision was extraordinarily useful in training the local staff of the agricultural department. Not only did these officers get a thorough insight into local agricultural practice and the difficulties with which the farmer had to contend, but a personal contact with the farming community was established and a mutual respect for each other's knowledge was created. In the early stages assistance had frequently to be given in drilling the crops on these seed farms and in training farmers or their farm servants in the handling of the drill and of implements for inter-cultivating the crop. One realized how dependent these farmers were on their cereal crops, and work on these had to have precedence over all else. It was useless trying to get inter-cultivation done till the farmers had

ploughed through their crops of Cambu. This seemed a drastic treatment to give, but, unless this was done, the plants would not tiller properly. We also learnt much from these farmers and incidentally adopted their method of preserving cattle manure on our agricultural station. This is always a scarce commodity on black cotton soils, because these require only one pair of bullocks to work about forty to fifty acres of land. Any manure made by these animals is placed in shallow pits. To this is added any waste material from the farm such as threshing-floor sweepings, as well as sweepings from the homestead. Periodically the matter in the pit is spread evenly and covered with black soil or soil dug from the bed of an irrigation tank. Some more progressive farmers go a stage further. When the pit is emptied the manure is carted to the field where it is to be applied. It is then heaped with alternate layers of tank silt, till it matures and is ready for use.

We discovered that certain villages were always noted for the quality of their cotton lint, while others were known to give either a high or a low ginning out-turn. Those in the extreme south usually gave a poor ginning out-turn, but this could hardly be wondered at, since the annual rainfall in that area was only about 12 inches a year, and in some seasons the soils would never be wet through. That our seed farm areas were considered to be above the average was evidenced by the fact that the crops were usually protected against the "evil eye." Sometimes this was merely a mud pot covered with white and coloured dots, and stuck on to the end of a stake in the field, but specially good crops would occasionally have more arresting effigies of human figures. I always understood that the object of these was to catch the eye before the crop was noticed and thus avert the influence of an envious regard.

There is much to be said for cotton improvement and the extension work being under one control. It is much easier to follow the behaviour of selections when grown under a variety of field conditions, and one also gets a far better idea of how the farmer reacts to them. Such district work also develops a degree of harmony between the agricultural officers and the farming community which is essential to progress.

Mentioning harmony reminds me that this was once seriously menaced in the Tinnevelly cotton tract. This occurred after our seed farms had been thoroughly established, and were it not for these and the healthy attitude to the farmers which the Department had created it is doubtful whether we would have been so successful in meeting this menace. Tinnevelly farmers pay great regard to

their working bullocks. These are constantly at work, and for the most part are accustomed to receive concentrated food. Moreover, at that time there was very heavy road traffic to the port of Tuticorin, not only from the cotton tract but from as far away as the Coimbatore district. All these cart bullocks received concentrates as well. Thus there was a great demand for cotton seed, and that locally produced commanded a high price. To supplement the local supplies, bazaar merchants had imported cotton seed from Northern India, and some of this happened to be used for seed. The resulting crops produced a heavy yield of seed cotton, which gave an excellent ginning out-turn. This acquired the name " Pulichai " cotton from its resemblance to Pulichai (*Hibiscus cannabinus*). This describes the type of plant—tall, straight-growing, with only sympodial branches. It proved quite hardy, it had a much larger boll than the local cotton, the lint was very white in colour, but it was extremely short in staple and harsh to handle. Its extension would have ruined the established name of " Tinnevelly " cotton and would have resulted in a general lowering of the value of the crop. Instead of having a valuable reputation for a long staple cotton, Tinnevelly would have had to compete with the short staple cotton districts of Central India. Fortunately at that time practically the whole of the " Tinnevelly " crop was ginned in two or three centres and was in the hands of three or four firms of established reputation. All these firms were seriously concerned in this new trend which cotton growing had taken, and they mutually agreed that none of them would buy any seed cotton which contained this admixture. In order to ensure their *bona fides* they agreed that the gazetted officers of the Agricultural Department should have access to their ginning factories so that they could inspect the cotton seed which came from the gins to see that there was no admixture. Fortunately the Pulichai cotton seed could easily be recognized both by its larger size and its colour. The buyers were in a very strong position. Each firm had its brokers and these had their dealers, who in turn had their sub-dealers, and these dealt with the villager dealers. The various dealers between the brokers and the village were the chief culprits in spreading this seed and in encouraging its cultivation; for they found that by a judicious mixing with Tinnevelly kapas or seed cotton they could palm this off as " Tinnevelly " cotton. The Agricultural Department also agreed that it would do its utmost to persuade the farmer not to grow this cotton, and where it was found growing to have it eradicated. This was a much more difficult task; for up to that time the farmers who had been growing this

Pulichai had been making a handsome profit, being able to dispose of it at the ruling prices for " Tinnevelly " cotton. I did not see the end of this fight against " Pulichai " cotton, as my charge owing to increasing duties had to be divided, and the " Tinnevelly " cotton area was made part of a new circle. The credit for the eradication of this should be given to Mr. R. Thomas, who was appointed Deputy Director to this area, and who was mainly responsible for the arrangements made for this most unpopular work.

I was very sorry to close my connection with the " Tinnevelly " cotton area where I made many friends among the farmers. It is always a pleasure to work among farmers who know how to farm, and this is specially so where farming is a matter of skill against adverse climatic conditions. It was further a matter of satisfaction to know that the work of the Department was appreciated and that the officers attached to the agricultural station, as well as those working in the district, had, by their knowledge of local conditions and of farming in general, gained the full confidence of the farming community among whom they worked. There is no doubt that the agricultural officer is fortunate in seeing the best side of life. This was once forcibly brought home to me when talking to the Superintendent of Police of this very area. He had an extensive knowledge of these black soil villages, but his acquaintance with the people seemed to be confined to the investigation of serious crime, in which circumstances naturally he met them under quite different conditions.

Received January. 1938.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

The general statistical position is dealt with in the special article on page 105 of this issue, so that here we have only to deal with some details of certain crops. The only other statement that may be added is that, as the result largely of a substantial reduction in the estimate of the China crop owing to the war, the total of Outside Growths this season is looking rather more like 20 million bales than the figure of 21 millions which we mentioned in the January issue.

India.—The statistics with regard to the Indian crop are slightly confused this year owing to the fact that Burma is now no longer included in the Indian figures, but is given separately. The latest information available is that the acreage in Burma last year was 519,000 acres, and the crop 113,000 bales. For the rest of India the figures given in our table are those of the February estimate, but as the revised figures for February, 1937, have not been cabled we can only give the Government's statement that the acreage shows an increase of 3 per cent. and the crop a decrease of 10 per cent. The acreage in Burma this year was given as 544,000 acres in October. It may also be noted that Ralli Bros.' estimate, which presumably includes Burma, has now been reduced to 7,370,000 bales against 7,773,000 last year.

The details by varieties in the February estimate have, as usual, not been cabled, but judging by the December figures it looks as if the percentages of long and short staples for the season would be about the same as last year.

Sudan.—In accordance with their usual practice the Sudan Government issued no estimate of the Gezira crop until January, but the figures now available, which are given in our second table, are fairly satisfactory. The acreage under Sakel in the Gezira shows a considerable increase, mostly in the Kassala Cotton Company's concession, but the yield is considerably lower. In Tokar, however, the acreage is less than half of last year's figure, and the average yield is also lower. In the River Gash area (Kassala) the acreage is slightly increased, but the average yield is lower. The total Sakel acreage shows a small reduction on last year and the yield is down by 166,633 kantars.

The American irrigated areas show a slight increase both in acreage and average yield, but the rain-grown areas show a slightly increased average yield on a smaller acreage.

Consumption.—The consumption figures for the first half of the season, so far as now available, are showing a very definite trend which is in marked contrast with the position a year ago. As the Federation's half-yearly figures will probably not be available in time for inclusion in this issue, we give here a summary of the U.S. Census Bureau's figures for the United States along with Garside's estimates of the consumption of American in other countries and of Outside Growths for the whole world. The main point is the serious decline of consumption in America, the details of which are given in our usual table on page 140. But the consumption of American in other countries has held up very much better and still shows a slight gain on last year. The World's consumption of Outside Growths, however, is also showing a considerable decline, whereas this time last year it was mounting up steadily. The result is that the estimated consumption of All Kinds for the first half of this season is 14,008,000 bales, against 15,070,000 a year ago. (P.S.—The preliminary Federation figures have just come in and are added to the table. They are substantially lower than Garside's.)

GARSIDE'S CONSUMPTION.—American v. Outside Growths (000's).

1936-37.	*American.*			*Outside Growths.*	*All Kinds.*		
	U.S.A.	*Others.*	*Total.*		*U.S.A.*	*Others.*	*Total.*
August	562	434	996	1,292	575	1,713	2,288
September ...	615	423	1,038	1,386	630	1,794	2,424
October	637	447	1,084	1,464	651	1,897	2,548
November... ...	613	453	1,066	1,456	626	1,896	2,522
December ...	681	446	1,127	1,531	695	1,963	2,658
January	665	444	1,109	1,521	679	1,951	2,630
1st Half ...	3,773	2,647	6,420	8,650	3,856	11,214	15,070
Season's Total	7,768	5,325	13,093	17,898	7,950	23,041	30,991
1937-38.							
August	586	428	1,014	1,356	604	1,766	2,370
September ...	584	462	1,046	1,352	602	1,796	2,398
October	513	507	1,020	1,378	526	1,872	2,398
November... ...	472	541	1,013	1,344	485	1,872	2,357
December ...	425	533	958	1,289	433	1,814	2,247
January	425	553	978	1,260	435	1,803	2,238
1st Half ...	3,005	3,024	6,029	7,979	3,085	10,923	14,008
Federation ...	3,005	2,780	5,785	7,653	3,081	10,357	13,438

American Carryover.—December is always the critical month in regard to the World's Carryover of American cotton, for the general trend of the season depends on whether the peak of the Carryover is reached at the end of November or not till the end of December. This year December showed an increase of 566,000 bales, which is the largest for this month since 1926, and January also showed a small increase for the first time since 1920. The monthly total of the Carryover at the end of January is 15,307,000 bales, against 10,403,000 a year ago, and this increase of nearly 5 million bales has probably not reached its maximum, for, judging by the progress of consumption to date, American may have difficulty in reaching a total of 12 million bales for the season, against a crop of over 18 millions.

To complete the mid-season Carryover we require the Federation's Mill Stocks as at January 31, but it is uncertain whether these will be available in time for inclusion in this issue.*

Prices.—In the January issue we were able to bring the history of the heavy decline of prices down to what was then the lowest point in October and November for New York, and October for Liverpool. Since then prices have been much better on the whole, partly as the result of the varying fortunes of the conflict between the authorities at Washington and Big Business in Wall Street, and latterly as the result of the developments of the Government's crop restriction policy for 1938, both of which have been described in the special article on page 105. The actual figures of prices to the end of February will be found in our usual table which follows.

The next table gives the usual details of the spot prices of other varieties of cotton in Liverpool expressed as percentages on American, and it will be seen that most of the changes are just about in line with the rise of the basis price of American since November. As a matter of fact, some of these quotations expressed in points on or off American frequently remain unchanged for weeks and even months on end.

* P.S.—Preliminary figures did come in and are included. U.S. figures for February are also now available and make the monthly total show the smallest reduction on record for that month.

INDIAN CROP.

(000's *Omitted.*)

	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.	1937–38* (*Feb.*)
Area (acres)...	22,483	24,137	23,972	25,999	25,219	25,334
Crop (Government estimate) 400-lb. bales	4,656	5,108	4,857	5,933	6,307	5,407
Average yield per acre (lbs.)	83	85	81	91	100	86
Staple ⅞ and above (bales)	1,347	1,365	1,255	1,954	2,102	
Per Cent. of Total ...	*28·9*	*26·7*	*25·8*	*32·9*	*33·3*	
Staple below ⅞ (bales) ...	3,310	3,743	3,603	3,979	4,205	
Per Cent. of Total ...	*71·1*	*73·3*	*74·2*	*67·1*	*66·7*	
Commercial Crop :						
Net exports (bales) ...	2,868	3,406	3,115	3,826	—	
Mill consumption ...	2,361	2,336	2,612	2,678	—	
Domestic consumption ...	750	750	750	750	—	
Total	5,979	6,492	6,477	7,254	—	
Per cent. on Government estimate	+28·4	+27·1	+33·3	+22·3	—	
Season's average spot price (Liverpool*—pence per lb.)	4·84	4·52	5·24	5·21	5·29	
Per cent. on American ...	86·1	75·1	75·6	79·9	74·3	
* No. 1 Fine Oomra						

* Excluding Burma.

SUDAN CROP.

	1936–37 (*Final*).				1937–38 (*January Estimate*).			
	Area: Feddans	*Crop: Kantars*	*Yield per Feddan*	*400-lb. Bales*	*Area: Feddans*	*Crop: Kantars*	*Yield per Feddan*	*400-lb. Bales*
Sakel :								
Gezira (Syndicate) ...	167,288	746,566	4·46	234,685	167,982	800,000	3·87	202,000
Gezira (Kassala Cotton Company) ...	31,837	144,341	4·53		38,671			
Tokar ...	43,000	119,226	2·8	31,187	20,000	40,000	2·00	9,900
Kassala (Gash Delta) ...	30,335	68,360	2·25	17,526	31,850	65,000	2·04	16,088
Others ...	12,024	45,067	3·74	11,270	14,173	51,719	3·65	12,800
	284,484	1,123,561	3·9	294,668	272,676	956,719	3·51	240,788
American :								
Irrigated ...	11,403	45,620	4 0	10,329	11,852	49,534	4·18	11,022
Rain-grown ...	161,300	124,293	0·76	27,690	142,198	121,200	0·85	26,967
Total ...	457,187	1,293,474	2·8	332,687	426,726	1,127,453	2·64	278,777

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(Running Bales 000's: "Foreign" in Equivalent 500-lb. Bales.)

1936-37.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
August ...	574·3	27·3	560·3	1·7	5·6	6·7	65·4
September ...	629·7	29·0	613·7	1·7	5·9	8·5	67·9
October ...	646·5	29·7	630·9	1·8	6·0	7·8	72·5
November ...	626·7	30·6	612·0	1·9	5·5	7·3	63·8
December ...	692·9	33·0	676·8	2·0	6·4	7·7	61·9
January ...	678·1	32·7	662·5	1·8	6·5	7·2	63·4
February ...	664·4	33·6	649·0	1·8	6·2	7·5	63·6
March ...	779·3	33·9	759·8	2·2	7·6	9·7	74·3
April	718·9	32·7	700·7	1·9	7·8	8·6	72·8
May	669·5	32·3	652·9	1·5	6·8	8·3	70·5
June	681·4	31·0	662·1	1·5	6·8	11·0	66·6
July	583·1	27·8	569·8	1·0	5·9	12·4	74·5
*Season's total**	7,950·1	—	7,747·9	20·1	77·9	104·2	818·9
1937-38.							
August ...	604·4	27·5	585·7	0·8	6·4	11·5	72·2
September ...	601·8	27·7	582·8	0·7	6·9	11·4	73·7
October ...	526·5	25·4	511·8	0·7	5·7	8·2	72·9
November ...	484·8	22·6	471·9	0·6	5·1	7·3	57·8
December ...	433·1	20·6	424·7	0·6	4·3	3·5	46·5
January ...	434·7	20·7	424·5	0·4	4·3	5·6	44·9
February ...	428·0	21·7					48·0

* Revised.

WORLD'S CARRYOVER OF *AMERICAN* COTTON.

(Running Bales 000's, excluding Linters in U.S.A.)

End of—	*Stock and Afloat.*			*U.S.A.*		*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.*	*Elsewhere in U.S.A.**
	U.K.	*Continent.*	*Orient.*	*Mill Stocks.*	*Public Warehouses.*				
1931, January ...	644	1,198	343	1,523	7,895	11,603	907	12,510	—
July ...	436	766	401	922	4,491	7,016	950	8,816	850
1932, January ...	506	938	805	1,583	10,019	13,851	1,193	15,044	—
July ...	415	729	695	1,163	6,657	9,659	1,379	12,798	1,760
1933, January ...	620	1,189	852	1,455	9,982	14,098	1,248	15,346	—
July ...	536	1,058	616	1,298	5,703	9,211	1,259	11,550	1,080
1934, January ...	617	1,367	752	1,557	9,469	13,762	1,320	15,082	—
July ...	405	734	590	1,172	5,526	8,427	1,132	10,509	950
1935, January ...	397	640	768	1,148	8,912	11,865	1,060	12,925	—
July ...	201	395	315	749	5,708	7,368	955	9,003	680
1936, January ...	493	614	565	1,405	7,823	10,900	858	11,758	—
July ...	321	359	195	855	3,907	5,637	793	7,005	575
August ...	280	291	172	710	4,304	5,757	—	—	—
September	322	430	254	811	6,773	8,590	—	—	—
October ...	382	519	352	1,367	8,003	10,623	—	—	—
November	381	600	444	1,760	8,395	11,580	—	—	—
December	460	613	470	1,971	7,768	11,282	—	—	—
1937, January ...	493	647	460	2,042	6,761	10,403	811	11,214	—
February	476	613	499	2,022	5,944	9,554	—	—	—
March ...	520	561	606	2,034	5,013	8,734	—	—	—
April ...	470	524	609	1,935	4,186	7,724	—	—	—
May ...	439	466	603	1,758	3,559	6,825	—	—	—
June ...	365	381	439	1,484	3,058	5,727	—	—	—
July ...	321	304	350	1 219	2,769	4,963	896	6,259	400
August ...	277	287	277	898	3,466	5,205	—	—	—
September	395	496	230	937	6,892	8,950	—	—	—
October ...	460	700	194	1,368	9,725	12,447	—	—	—
November	648	790	175	1,608	11,513	14,734	—	—	—
December	804	835	161	1,671	11,829	15,300	—	—	—
1938, January ...	870	801	187	1,716	11,733	15,307	984	16,291	—
February	883	785	230	1,768	11,617	15,283	—	—	—

* Included in total.

HIGHEST AND LOWEST FUTURES PRICES.

1936–37.	*American.*				*Egyptian (Liverpool).*			
	New York.		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
August ...	12·16	*11·30*	6·53	*6·10*	10·79	9·96	7·49	6·99
September	12·30	11·50	6·68	6·13	10·18	*9·67*	7·32	*6·91*
October ...	12·21	11·51	6·78	6·51	10·80	9·93	7·45	7·14
November	11·92	11·51	6·75	6·46	10·91	9·93	7·36	7·17
December	12·54	11·85	6·89	6·54	10·24	9·80	7·77	7·31
January ...	12·85	12·24	7·15	6·73	10·15	9·83	8·05	7·61
February	12·77	12·36	7·16	6·89	10·15	9·49	8·40	7·83
March ...	*14·70*	12·79	*7·96*	7·18	*12·50*	9·89	*9·73*	8·39
April ...	14·53	12·76	7·94	7·00	12·48	10·60	9·72	8·75
May ...	13·19	12·58	7·33	6·94	11·15	10·36	9·40	8·83
June ...	12·75	11·79	7·14	6·62	9·44*	8·68*	8·48	7·91
July ...	12·58	10·75	6·92	5·93	8·84	7·90	8·42	7·46
1937-38.								
August ...	11·01	9·15	6·06	5·28	7·96	7·35	7·57	6·63
September	9·40	8·15	5·42	4·81	7·63	6·76	6·64	6·00
October ...	8·37	7·50	4·84	4·32	6·86	5·89	6·08	5·31
November	8·12	7·50	4·63	4·34	6·56	6·19	5·73	5·40
December	8·45	7·86	4·83	4·53	6·95	6·39	5·90	5·54
January ...	8·64	8 23	4·91	4·70	7·18	6·82	6·06	5·78
February	9·33	8·48	5·20	4·80	7·43	6·98	6·34	5·84

Maximum and minimum each season in italics.
* Quotation changed to Giza 7.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (Last Friday of Each Month).

1936–37.	*American (Middling). Pence per lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil.*		*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
				Pernam (Fair).	*San Paulo (Fair).*				
August ...	6·70	74·0	97·0	91·8	94·0	104·5	117·9	117·3	153·4
September	6·73	76·1	99·3	94·1	96·3	106·7	117·8	109·5	150·8
October ...	6·81	74·0	100·3	95·2	97·4	106·9	123·0	106·5	167·6
November	6·72	75·0	98·8	95·1	97·3	107·7	124·1	109·8	170·4
December	7·10	75·4	98·6	94·4	96·5	107·0	125·4	110·3	146·5
January ...	7·34	73·3	98·6	94·6	96·6	106·8	130·7	111·9	139·6
February	7·41	71·0	97·6	92·8	96·2	106·3	130·0	114·3	137·8
March ...	7·95	73·2	98·7	94·3	97·5	106·9	125·8	122·1	159·5
April ...	7·22	74·2	98·6	93·8	97·2	107·6	128·4	128·1	155·1
May ...	7·36	74·3	98·6	93·9	97·3	107·5	127·9	133·0	157·1
June ...	6·95	77·3	98·6	93·5	97·1	107·2	125·9	137·8	144·6
July ...	6·12	75·5	98·0	93·1	97·2	108·7	128·3	142·2	147·9
Season's average	7·11	74·3	98·5	93·7	96·5	106·6	124·3	118·8	152·0
1937-38.									*Giza 7.*
August ...	5·63	78·2	97·3	92·0	96·4	107·1	130·2	136·4	145·3
September	5·08	75·8	97·0	91·1	98·0	107·9	133·5	132·9	151·2
October ...	4·83	77·0	95·9	90·7	99·0	108·3	142·4	129·0	160·9
November	4·64	81·5	96·8	91·4	100·0	109·7	145·3	128·2	153·7
December	4·84	78·7	96·9	91·7	100·0	109·3	141·3	128·1	153·3
January ...	4·82	77·8	96·9	91·7	100·0	109·3	141·5	125·5	153·9
February	5·21	77·9	97·0	92·1	100·0	108·5	138·4	122·6	149·5

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

200. Report on the Work of the Indian Trade Commissioner During 1936-37. By Sir David Meek. (Off. of High Commissioner for India, London, 1937. Price 4s. 8d.) Contains much useful information in connection with modern trade tendencies; agricultural products—foodstuffs and industrial materials; Indian timbers; lac and shellac; Indian minerals; trade publicity; committees and conferences. During the period under review the Lancashire Indian Cotton Committee continued its work of popularizing Indian cotton in Lancashire. The imports into the United Kingdom were expected to exceed considerably the imports of the previous season.

201. Indian Cotton: Review of the 1936-37 Season. We have received from Messrs. Chunilal, Mehta and Co., Bombay, a copy of the *Indian Cotton Review for the* 1936-37 *Season*. According to the final forecast of the Government, the area under cotton was 25,219,000 acres, compared with 25,999,000 acres in the previous season, and production was estimated at 6,307,000 bales, against 5,933,000 bales in 1935-36. The acreage decreased by some 3 per cent., owing to competition from groundnuts, but production increased by a little over 6 per cent. Exports during the season reached 4,325,000 bales. The consumption of Indian cotton by Indian mills amounted to 2,625,000 bales.

Prospects for 1937-38. The crop made a good start, and if normal conditions continue a crop of 6,800,000 bales is anticipated.

Several statistical tables are included in the report, dealing with the world supply, distribution, and stocks of Indian cotton, Indian cotton acreage and production, consumption by mills, exports, Bombay cotton prices, etc.

202. Report on the Work of the Imperial Council of Agricultural Research in Applying Science to Crop Production in India. By Sir John Russell, F.R.S. (*Madras Agr. J.*, xxv., **11**, 1937, p. 331.) The author is of opinion that the more purely non-technical research should be handed over to the Universities, with grants in aid. It is considered that the results of research are not widely enough known, and that the Council should take steps to see them put into practice. The main problem, *i.e.* the increase of productiveness, is discussed, and the special difficulties of Indian agriculture, such as the absence of an educated middle class actually engaged in farming, are considered and suggestions made. One great difficulty is the bridging of the gap between the Experiment Stations and the cultivator. Another important line of work is to attend to soil conservation and erosion. To carry out the work suggested an increased grant to the Council is necessary, and is definitely recommended.

203. Scientific Reports of the Imperial Agricultural Research Institute, New Delhi, 1937. (Manager of Pubns., Delhi, 1937. Price Rs. 3 or 5s. 3d.) A brief survey of research carried out during the period 1905-36. Cotton is not included.

204. Agriculture and Animal Husbandry in India, 1935-36. (Manager o Pubns., Delhi, 1937. Price Rs. 4-10, or 7s. 6d.) The report deals with agricultural conditions during 1935-36; economic work on crops; research in crop production; agricultural marketing and engineering; livestock; veterinary

and animal husbandry research; agricultural education; the co-operative movement as affecting agriculture, etc.

In connection with cotton, statistics are given of cotton acreage, production, and exports. The progress made by the Indian Central Cotton Committee in the improvement of the growing, marketing, and manufacture of cotton, and the various research schemes financed by the Committee are discussed. An account is also included of the work of the Indore Institute of Plant Industry during the season.

205. Indian Central Cotton Committee. At the 36th meeting held on January 25 and 26 last, the following, among other important matters, were discussed: the cotton marketing survey for all India; the situation created by the low level of prices of Indian cotton; the reservation of areas for the cultivation of 1027 A.L.F. and 1A cottons; the mixing of desi and American cottons in the Punjab. The Progress Report of the Director, Technological Laboratory, was presented, and appreciation was expressed of the work that is being carried out there. Several new agricultural and seed distribution schemes were considered. The sincere thanks of the Committee were tendered to the Corporation for loaning the services of Dr. T. G. Mason, F.R.S., to examine and report on the causes of the periodical partial failures of Punjab-American cotton in the Punjab in certain years. Dr. Mason's report contains definite and helpful conclusions and indicates several promising lines of future work.

206 Indian Central Cotton Committee: Report of the Technological Laboratory, 1936-37. (Ind. Cent. Cott. Comm., 1937. Price 6 annas.) During the season under review 247 spinning tests were completed on various cottons; tests were also carried out on samples of trade cottons supplied by the East India Cotton Association, the Bombay Millowners' Association, and the Ahmedabad Millowners' Association. Some 175 tests on the fibre properties of different samples were carried out by the Fibre Testing Section, and the Physics and Chemistry sections were also fully occupied. Four technological bulletins were issued during the period under review.

207. Supply and Distribution of the Various Types of Indian Cotton, Season 1935-36. (*Stat. Bull. No.* 6, Ind. Cent. Cott. Comm., 1937.) A useful pamphlet giving statistical and other information concerning (*a*) the area under improved varieties of cotton in the 1934-35 and 1935-36 seasons; (*b*) supply and distribution of the various types of Indian cotton during the twelve months commencing September 1, 1934-35 and 1935-36; (*c*) the Indian cotton crop of 1935-36 classified according to length of staple; (*d*) stocks of Indian raw cotton held in India by the mills and the trade on August 31, 1935 and 1936; (*e*) stocks of Indian cotton held by the mills and the trade in the Madras Presidency on January 31, 1937; (*f*) receipts at mills in India of raw cotton classified by varieties; (*g*) exports by sea of Indian raw cotton classified by varieties.

208. Technological Reports on Standard Indian Cottons, 1937. By N. Ahmad. (*Tech. Bull. Ser. A. No.* 39, Ind. Cent. Cott. Comm., 1937.) The reports contain the results of tests on standard Indian cottons of the thirteen seasons, 1924-37. As in former years the agricultural details, grader's report, fibre particulars, spinning tests and remarks are given for each of the twenty varieties tested. Eight cottons show an improvement over last year, four gave practically the same result, while eight cottons show a falling off. Improvement was most pronounced in C402 and Karunganni C7 varieties, and less so in Verum 262 (Akola) cotton. The improvement noticed last year in Sind Sudhar cotton was not maintained, and this variety had to yield first place as regards spinning performance to the Punjab-American 289F cotton.

209. TECHNOLOGICAL REPORTS ON TRADE VARIETIES OF INDIAN COTTONS, 1937. By N. Ahmad. (*Tech. Bull. Ser. A., No.* 38, 1937. Ind. Cent. Cott. Comm.) The grader's report and spinning test results are given for twenty-six representative trade varieties of cotton supplied by the East India Cotton Association, twenty varieties by the Bombay Millowners' Association, and three by the Ahmedabad Millowners' Association.

210. THE EFFECT OF DIFFERENT DEGREES OF COMPRESSION ON THE FIBRE PROPERTIES AND SPINNING QUALITY OF INDIAN COTTONS. By N. Ahmad. (*Tech. Bull. Ser. A., No.* 40, Ind. Cent. Cott. Comm., 1937.) The results of the investigation indicated that pressing cotton bales to a density of 40 lb. per cubic foot did not injure the fibre, and reducing the density to 20 lb. per cubic foot effected no improvement in spinning performance.

211. INDIAN COTTON YARNS: LEA STRENGTH AND COUNT RELATIONSHIPS. By N. Ahmad. (*Ind. Text. J.*, 48, 1937, p. 13. From *Summ. of Curr. Lit.*, xviii., 1, 1938, p. 17.) The formula $S_2=[C_1S_1-(C_2=C_1)K]C_2$ for predicting the lea strength (S_2) of a specified count (C_2) from that (S_1) of a known count (C_1) recently given by Campbell for American cottons, in which the value of K varies between 15·9 and 25·1, does not fit in very well with the results available for Indian cottons. On analyzing the results of lea tests for 1,133 Indian cottons, each of which had been spun into three counts, it was found that by dividing these cottons into ten groups according to their spinning capacity, it was possible to obtain a range of values of K, which, on being inserted in the formula, gave a remarkably good agreement with the experimental results. The method of determining the value of K for any given range of counts is explained; its value for 24's is 35. Examples are worked out.

[*Cf.* Abstr. 751, Vol. XIV. of this Review.]

212. BOMBAY COTTON ANNUAL, 1936-37, No. 18. (East Ind. Cott. Assen., Ltd., Bombay. Price Rs. 1-8-0.) The usual authoritative compendium of all matters relating to every branch of the cotton trade. It contains numerous statistical tables of crops, exports, imports, prices, stocks, consumption, Government notifications, etc. The book is designed to meet the requirements of all who are interested in the production, distribution and consumption of Indian and foreign cottons, yarns, and cloth.

213. MADRAS: *Cotton Industry*, 1937-38. (*Madras Agr. J.*, January, 1938, p. 37). Insufficient rainfall during the North-East monsoon adversely affected the Coconadas cotton in parts of the Guntur district. The yield of the early-sown cotton is expected to be appreciably below normal owing to drought. The late-sown cotton is also suffering from drought in Bellary and Anantapur. Elsewhere in the province the condition of the crop is fairly satisfactory.

214. MYSORE: *Cotton Investigations*, 1935-36. (*Rpt. of Dpt. of Agr.*, 1935-36, recently received.) Investigation work to evolve cottons suitable for the various districts was continued. Selection 69 and H. 190 are promising varieties, but are not wilt-resistant; good results were obtained with M.A. 11, Jayawant, and N.T. 38, in the Irwin Canal tract. Damage to cotton was caused by the cotton stem-borer (*Sphenoptera gossypii*) and also by red leaf disease. A scheme has been financed by the Indian Central Cotton Committee for three years for the investigation of the disease.

215. PUNJAB: *Cotton Industry*, 1936-37. (*Seasonal Notes*, Punjab Agr. Dept., xvi., 2, 1937.) A record area was planted to cotton of 2,909,152 acres, and the yield was 1,467,996 bales, which also constituted a record for the province. Two promising strains of cotton were evolved by the botanical section of the Depart-

ment of Agriculture: an early strain of Punjab-American of finer quality, greater staple length and better ginning outturn than 43F, and a new desi cotton, named Jubilee, with a staple length almost equal to Punjab-American 4F.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

216. The following reports have recently been received:
IMPERIAL INSTITUTE: Ann. Rpt. for 1937.
SOUTH-EASTERN AGRICULTURAL COLLEGE, WYE: The Journal, January, 1938.
BRITISH HONDURAS: Ann. Rpt. of Dpt. of Agr., 1936.
CYPRUS: Ann. Rpt. of Dpt. of Agr., 1936.
FIJI: Ann. Bull. of Div. Rpts., 1936.
GOLD COAST: Rpt. of Dpt. of Agr., 1936-37.
NIGERIA: Ann. Rpt. of Dpt. of Agr., 1936.
" Ann. Rpt. on Govt. Rlys. and Colliery of Nigeria, 1936-37.
NYASALAND: Ann. Rpt. of Agr. Dpt., 1936.
SOUTH AFRICA: South African Year Book, 1937.
SUDAN: Rpt. of Admin. Finan. and Condns. of Sudan in 1936.
" Ann. Rpt. of Dpt. of Agr. and Forests, 1936, Pt. I.
TANGANYIKA: East Afr. Agr. Res. Sta. Amani; 9th Ann. Rpt., 1936-37.
WEST INDIES: *Barbados*, Agr. Jour. of Sci. and Agr., 1936, Vol. VI., No. 2.

217. PROGRESS REPORTS FROM EXPERIMENT STATIONS, 1936-37. (Pubd. by the Empire Cotton Growing Corporation, 1938. Price 2s. 6d., post free.) Progress reports are included summarizing the work carried out during the 1936-37 season at the Cotton Experiment Stations in Queensland, South Africa, Swaziland, Rhodesia, Sudan, Uganda, Tanganyika, Nyasaland, St. Vincent, Fiji, and the Seed Farm in Nigeria. Reports from the stations in Northern and Southern Nigeria have again been included by courtesy of the Government of Nigeria.

Good progress was made with the important breeding work carried out at the various stations. U.4 and its derivatives having occupied South Africa, Southern Rhodesia and Nyasaland are now competing hard for preference with the best local selections in several districts in Tanganyika and in the eastern area of Uganda. The valuable work in connection with the control of cotton pests and diseases was continued, and much useful work was carried out in connection with the rotation of crops, spacing, cultural, and fertilizer experiments.

To those concerned with the cultivation of cotton and similar crops these reports should prove of interest and value.

218. THE WORK OF THE EXPERIMENT STATIONS, SEASON 1936-37: AN EXPLANATORY REVIEW. By W. Nowell. (Pubd. by the Empire Cotton Growing Corporation, 1938. Price 1s. 6d., post free.) A very useful review. Following a general survey of the situation in Africa, to which continent most of the reports reviewed have reference, brief and easily readable accounts are given of the work carried out at the various experiment stations of the Corporation and of the progress made.

219. IMPERIAL INSTITUTE. The Annual Report for 1937 indicates a year of progress. In the Plant and Animal Products Department 1,192 enquiries were dealt with, and reports furnished on 331 samples. In the Mineral Resources Department 1,101 enquiries were dealt with, and reports were made on 125 investigations, which involved the examination of 317 samples. The series of special lectures on various subjects attracted large audiences, and a more extensive programme for 1938 is in course of preparation. 4,220 new books, official reports, and pamphlets were added to the Library during the year.

220. REPORT OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, 1936-37. (Cmd. 5647, H.M. Stat. Off., 1938. Price 3s. net.) Contains the reports of the Committee of the Privy Council and of the Advisory Council, and a review of the work carried out under the supervision of the Boards and Committees of the Department, together with a section describing the work of Research Associations. A brief account is included of the work of the British Cotton Industry Research Association.

221. BRITISH HONDURAS: *Cotton Industry*, 1936. (*Ann. Rpt. of Dpt. of Agr., Br. Honduras*, 1936.) Marie Galante cotton gave a poor yield on account of the wet weather experienced soon after planting; the Heaton strain of Sea Island from Montserrat, however, showed some promise. Much injury to cotton was caused by stainers, and it is feared that with the large number of alternative host plants available for this pest a close season would not be of benefit.

222. ASIA. CEYLON: *Notes on Village Cotton Cultivation in the Hambantota District during the* 1936-37 *Crop Season*. By G. Harbord. (*Trop. Agriculturist*, December, 1937, p. 361.) There was a keen demand for cotton seed for the 1936-37 crop, and notwithstanding unfavourable weather in April the results obtained were encouraging in that there was a distinct improvement in acre yields and in the quality of the seed cotton. Cotton suffered little from pests; leaf roller was controlled by predatory wasps, and bollworm and stainers were not much in evidence. In all localities there was marked improvement in the cultivation and picking methods employed. A total amount of Rs. 29,246.89 was paid to the growers by the Divisional Agricultural Office.

223. CYPRUS: *Cotton Industry*, 1936. (*Ann. Rpt. of Dpt. of Agr.*, 1936.) The area under cotton was 10 per cent. less than in 1935, and the estimated production was 1,282,828 okes compared with 2,234,900 okes in 1935. The average yield for both irrigated and unirrigated cotton was 92·4 lb. per donum as against 145·67 lb. per donum in 1935. (1 oke $=2\frac{4}{5}$ lb., and 1 donum $=\frac{1}{3}$ acre). Statistics are given of area, production of seed cotton, quantity and value of exports of both lint and seed for the past five years. During the year efforts were made to improve the cotton industry. Pure Mesowhite seed was multiplied for issue in 1937, and all cultivators in Potamia and Ayios Sozomenos agreed to plant only this variety in that year. The yield and quality of Mesowhite are considerably superior to the mixed types usually grown. The results of sowing date, fertilizer, spacing and irrigation experiments with this cotton are given. In varietal trials with Cyprus selected, U.4, Giza 11, Giza 7, Gadag, and Titsiros, the Giza 11 strain gave the highest yield. Severe damage to cotton was caused by pink bollworm, particularly to late-sown crops, and arrangements were made for the installation of a machine for the treatment of cotton seed by heat to destroy overwintering larvæ in the seed.

224. AFRICA. COTTON PRODUCTION IN BRITISH EAST AFRICA. By P. K. Norris. (*U.S. Dpt. of Agr., Bur. of Agr. Econ.*, Washington, D.C., 1937.) An interesting account of the history of cotton production in British East Africa; the present importance of the industry; area available for expansion; soils and rainfall; insect pests and diseases; costs of production; marketing; ginning, etc.

There are large areas in East Africa where climatic conditions are suitable for cotton cultivation. The potential labour supply is adequate; transport, though expensive, is sufficient to handle a reasonable increase in cotton shipments, and there is a ready market for East African cotton abroad. Factors tending to retard the progress of the industry at present are the heavy transport costs and the losses from pests and diseases. Taking all factors into consideration,

however, the acreage is expected to increase, and East Africa may produce as much as 500,000 bales annually, and may eventually produce 1,000,000 bales.

225. LAND AND LABOUR IN NATIVE RESERVES. By W. G. Leckie and W. L. Watt. (*E. Afr. Agr. Jour.*, iii., 1, 1937, p. 37.) A discussion of the problems concerned with labour, transport, and land utilization that have to be faced in East Africa, as in other similar territories, in the creation of a new rural system to replace one which has outlived its usefulness.

226. GOLD COAST: *Cotton Selection Work*, 1936-37. (*Rpt. of Dpt. of Agr.* 1936-37.) Selection of strains of Ishan types of cotton suitable for local farmers was continued in collaboration with the Botanist, and tests were made of the effects of interplanting cotton with yams or okros. At Kpeve Agricultural Station experiments with cotton were adversely affected by the uneven distribution of the rainfall.

227. KENYA COLONY: *Soil Erosion.* (*Crown Colonist*, February, 1938, p. 110.) The announcement of the grant of £10,000 and a loan of £24,000 from the Colonial Development Fund for the purpose of combating soil erosion was received with great satisfaction, though it was feared that without some form of compulsion in the Reserves the money might not be utilised to the best advantage. The Colonial Office has also received from New York an offer of two travel fellowships to assist in the visit of soil conservation officers to study the measures that are being taken in the United States to combat erosion. One of these has been offered to Kenya and has been accepted.

228. NIGERIA. *Cotton Cultivation*, 1936-37. (*Half-yearly Rpt. of Dpt. of Agr. to Sept.* 30, 1937.) *Northern Provinces.*—Seed distribution was rather less than in the previous season owing to the increased cultivation of groundnuts. Weather conditions were unfavourable in the early part of the season and planting was delayed, but later weather conditions improved, and it was anticipated that if good rains fell in October production would amount to 40,000 bales or slightly over. In 1936 production worked out at an average of 7·4 bales of cotton per ton of seed distributed, and it is expected that this will be slightly exceeded in 1937. There was further restriction in the issue of Buying Area Licences, which should result in higher quality cotton being bought from buying areas. The Cotton Regulations worked satisfactorily.

Southern Provinces.—The total purchases of Improved Ishan cotton amounted to 5,428 bales, which was much in excess of what was expected early in the season. The reorganization of the Meko Seed Multiplication Scheme resulted in some 30 tons more seed coming from this area than last year.

229. NYASALAND. *Road Bridges.* (*Crown Colonist*, January, 1938, p. 15.) A number of road bridges have recently been constructed. On the Limbe-Mlanja-Quilimane road the Ruo river has been bridged by the erection of four 20-foot spans of reinforced concrete and one 100-foot steel span. The piers and abutments are in granite masonry. On the Limbe-Cholo-Mlanja road the Tuchila river has been twice bridged, the structure in both instances consisting of seven 16-foot arches built in local brickwork, and one 100-foot steel span. A new low-level bridge crossing the Wankulumadzi river on the Blantyre-Salisbury road is typical of the type of construction adopted when rivers are subject to sudden floods of short duration. The bridge consists of three 30-foot spans of concrete decking, carried on rolled steel joists, and twelve 12-foot concrete spans reinforced with old railway track. The piers and abutments are of stone masonry. A high-level bridge is being constructed over the Shiré river about four miles below the Matope crossing.

230. NORTHERN RHODESIA: *The Soils, Vegetation and Agricultural Systems of North-Western Rhodesia: Report of the Ecological Survey.* By C. G. Trapnell and J. N. Clothier. (Govt. Printer, Lusaka, N. Rhodesia. 1937. Price 15s.) The Ecological Survey of North-Western Rhodesia was financed jointly by a grant from the Colonial Development Fund and by the Loan Funds of the Territory, and was undertaken in 1932-34. The reduction of the accumulated data to the compass of this publication was a formidable task, and the result is a valuable book of reference rather than a report. Much information on pure Plant Ecology has been omitted in favour of an ecological classification of the country for agricultural purposes. Part I. of the report, under the heading of Soil and Vegetation Survey, deals with climate and physiography, the main soil classes, and vegetation types. In Part II. tribal agriculture, crops and livestock, and native agricultural systems are dealt with. Part III. discusses the improvement of native agriculture; forest protection in native areas; and the development of natural and of agricultural products. Several maps and illustrations are included in the report.

231. SOUTH AFRICA. *The South and East African Year Book and Guide for* 1938. (Edited for the Union Castle Mail Steamship Co., Ltd., by G. Gordon Brown.) This is the 44th edition of this very valuable publication. It contains useful information about the voyage out to South Africa, costs of living, hotel tariffs, motoring and aviation, education, native races and languages, sights and scenery, etc. An interesting history of South Africa and the Rhodesias is included, and climate and topography are also well treated. The individual states are then described in detail, followed by sections dealing with labour, native problems, co-operation, irrigation, farming, diseases and pests, mining, etc. For the benefit of the business man details are given of postal and telegraphic regulations, Ottawa Preferences, licences and stamps, income tax regulations, local weights and measures, currencies, etc. For the benefit of the immigrant practical information is given on the acquisition of land, land laws, agriculture generally, and the pastoral industry. Much useful information is also included for the benefit of the tourist and the sportsman. The gold industry, with the remarkable developments now taking place, is discussed at considerable length. The first part of the book concludes with a description of thirty-six different routes of travel. The second half of the publication is concerned in a similar manner with East Africa. A series of excellent maps concludes the volume; many of these have been specially drawn for the book, and are unobtainable elsewhere. The index, covering 49 pages, includes over 4,000 place names, and is practically a gazetteer. The price of the book is 2s. 6d. (3s. post free in the United Kingdom, 3s. 3d. elsewhere), and it is indispensable to all who have interests in South and East Africa.

232. SUDAN. *Agricultural Research Service*, 1935-36. (*Rpt. on Admin. Finan. and Condns. of the Sudan in* 1936, recently received.) The work of centralizing agricultural research at Wad Medani proceeded during the year, and the provision of the accommodation needed was undertaken. A model ginnery was also erected at the Research Farm. In view of the rapid development of cotton growing in the Nuba Mountains a sub-station of the plant breeding section was equipped and opened at Kadugli. The Empire Cotton Growing Corporation kindly provided the services of an experienced plant breeder to take charge of the work there. One-third of the total area in the Gezira was sown with the new X1530 strain, the final yield averaging 3¾ kantars per feddan. It is probable that this strain will shortly be superseded by an even better variety, X1730A, which is of the same general type, but is slightly superior both in

yield and quality of lint. Manurial experiments carried out at the Research Farm tended to show that cotton-seed refuse in the form of cake or meal was not of any great value as a manure, and that calcium nitrate was considerably more efficacious than sulphate of ammonia, weight for weight of nitrogen. Satisfactory results were obtained in an attempt to minimize the losses caused by white ants; Paris green and sawdust had a definitely deterrent effect. Investigations were also carried out on the Helopeltis bug, since the successful establishment of cotton in the Equatorial Province appeared to depend largely on the control of this pest. The new cotton variety " 513 " gave a remarkable yield, and also suffered less than other strains from pink bollworm.

233. *The Interrelation of Factors Controlling the Production of Cotton under Irrigation in the Sudan, with Special Reference to Variety.* By G. B. Portsmouth. (*Emp. Jour. of Exp. Agr.*, v., **20**, 1937, p. 318.) The new variety X1530 was compared with Sakellaridis under certain of the cultural conditions associated with the Gezira Irrigation Scheme. Experiments were carried out on three different sites representative of the north, centre, and south Gezira, and comparisons were made of varieties, sowing-dates, and spacings in different combinations. X1530 proved markedly superior to Sakel under all the conditions tested, and gave a 35 per cent. greater yield of seed cotton. The interaction of place and variety was negligible. The importance of close spacing to obtain maximum yields was again brought out, and this confirmed the conclusions obtained from earlier experiments. The optimum sowing-date exhibited the usual seasonal variation when compared with other years, but the more marked importance of early sowing in the south, in order to obtain maximum yields, appears to be established.

234. TANGANYIKA TERRITORY: *East African Agricultural Research Station, Amani.* (*Ninth Ann. Rpt.*, 1936-37.) Contains the reports of the Acting Director, Plant Pathologist, Entomologist, Soil Chemist, Biochemist, Plant Physiologist, Geneticist, Systematic Botanist, Superintendent of Plantations, Secretary and Librarian. Research continued to make substantial progress during the year, and 29 memoirs were published. Good progress was also made at the Kwamkoro Estate, where over 250 acres have been developed within 15 months. The whole of the maintenance of the Library is now met from the income of the Carnegie Trust Fund. Apart from periodicals and pamphlets, 59 volumes were added during the year. The Amani buildings were maintained in reasonably satisfactory repair, but the ravages of termites in some of the older houses will necessitate their partial rebuilding in a few years.

235. *Cotton Industry*, 1936-37. (*Crown Colonist*, February, 1938, p. 112.) The drop in prices caused a setback in trade in the Lake Province. In the Eastern Province planters are holding their cotton for an improvement in price; most of the natives have sold their crops. The Rufiji area produced its record crop, but the total production of the Eastern Province will not exceed that of last year.

236. *Roads and Bridges.* (*Crown Colonist*, January, 1938, p. 14.) Road communications are being rapidly developed throughout the Territory, and a construction programme of approximately 1,000 miles of new roads, commenced in 1934, is now nearing completion. A high standard of bridge construction is being followed for these and all new road projects, as exemplified by the Ruaha bridge on the Dodoma-Iringa section of the Great North Road (800 miles) linking Rhodesia with Kenya. The estimated cost of the new 1,000-mile programme is £195,000.

237. UGANDA: *Cotton Prospects*, 1937-38. The latest report from the Department of Agriculture is to the effect that weather conditions generally have been favourable. In the Eastern Province some damage to plants has been caused by locusts, bollworm, and boll rot, but on the whole the prospects are above the average.

238. *Manurial Experiments*, 1937. (*Bull. Imp. Inst.*, xxxv., **4**, 1937, p. 490.) A continuation of an experiment commenced in 1933, to compare varying amounts of farmyard manure and lime applied prior to a green manure crop as a measure for increasing the yields of commercial crops and as a possible measure of keeping up fertility. The rotation used was: First year: green manure, cotton; second year: millet, cotton; third year: groundnuts. The manure was applied at the rate of 10 tons, 20 tons and 30 tons per acre, and the lime at the rate of 2 tons per acre before the green manure.

The experiment commenced its second cycle in 1936, and the results obtained from the cotton crop were in favour of manuring. There was no significant difference between the three applications of manure, but they all gave significantly greater yields than either the limed or the control plots. The results obtained from the same crop in the first cycle were not significant, while the combined results from the whole of the first cycle, worked out on the cash value of crops, showed no difference between the manured plots and the control, though the former gave a significantly higher return than the limed plots. The trend of the experiment would seem to indicate that while the land was in good heart the application of manure was unnecessary, but as the soil is losing structure and becoming impoverished manuring is becoming more beneficial.

The manufacture of compost was continued during the early part of the year, the Indore system being modified to simplify it as much as possible and at the same time lower the cost of manufacture. With this in view compost was made of a single material, namely *Imperata cylindrica*. This grass is present in abundance in most parts of the Eastern Province of Uganda ; it is useless for grazing, but provides ample bedding throughout the whole year. The material was not chaffed or crushed in any way before being used for bedding, in order to keep the cost as low as possible; instead the heaps of compost were given two extra turns and allowed a longer period for rotting. Watering and turning were done at weekly and fortnightly intervals. The resultant compost from this tough grass was low in nitrogen content, but proved excellent as a top dressing.

239. AUSTRALASIA. QUEENSLAND: *Cotton Growing in Queensland*. By W. G. Wells. (*Jour. of Aust. Inst. of Agr. Sci.*, iii., **3**, 1937, p. 147.) An interesting account of cotton growing in Queensland, dealing with the early history, the present revival, the organization of the industry, the value of cotton growing to Queensland and also to Australia.

The early success attained eighty years ago died out with the fall of prices, but interest in the crop revived about 1919, and the problems that have to be solved in connection with its desired extension are clearly dealt with. When grown in a proper rotation cotton is undoubtedly well suited to large areas in Queensland, and is required by many farmers. The industry is an extensive employer of labour in both the growing and manufacturing phases, and its expansion, therefore, is of the utmost importance to the Commonwealth as a whole.

240. *Cotton Culture*. By W. G. Wells. (*Queensland Agr. J.*, September, 1937, p. 281.) An interesting article giving a general idea of cotton cultivation in Queensland, and containing information regarding the following: Suitable soils;

pure seed supplies; cotton varieties; preparation of seed-bed; planting, spacing, cultivation and thinning methods; harvesting; packing; grading; ginning; marketing. The value of cotton-seed by-products is also discussed. Much useful research work is being carried out at the Callide Cotton Research Station; the various problems arising in the cotton districts are studied there, and valuable assistance has been afforded in explaining the causes of, and helping to overcome, the difficulties that have been experienced in many of the cotton areas.

241. *Suitable Varieties of Cotton for the* 1937-38 *Season.* By R. W. Peters. (*Queens. Agr. J.*, September, 1937, p. 352.) The varieties suggested are Half-and-Half and Ferguson for alluvial soils of fair to good fertility; Lone Star and Miller for clay loam soils.

242. Fiji: *Cotton Industry,* 1935-37. (*Ann. Bull. of Div. Rpts.*, 1936, recently received.) The 1935-36 season was a poor one owing to the very unfavourable weather conditions experienced. The varieties cultivated were Sea Island and Fiji Backcross No. 172. The average yield of seed cotton per acre of Sea Island was 236 lb., and of Fiji Backcross No. 172, 435 lb. A definite policy of encouragement of cotton planting by the Government aroused increased interest in the crop, which it is hoped will gradually become an integral part of mixed farming outside the sugar-cane areas. Breeding and selection work were continued to maintain the purity and grade of Sea Island and to improve and stabilize the lint characters of Fiji Backcross. Jassid and tipworm were the chief pests encountered during the season; blackarm caused a fair amount of shedding, but stainer was little in evidence.

Prospects for the 1936-37 season were distinctly better, at the time of writing, in spite of inclement weather. The policy of the Government is gradually having a useful effect in stimulating interest in cotton, and an increased number of growers now plant the crop.

243. WEST INDIES. West Indian Sea Island Cotton Association. (*W. Ind. Comm. Circ.*, 30/12/37, p. 513.) The Fifth Annual Meeting of the Association was held in Antigua in November last. Mr. G. A. Jones, Commissioner of Agriculture for the West Indies, and President of the Association, gave a résumé of the Sea Island cotton situation during recent years, and appreciation was expressed of the help afforded by the West India Committee, British Cotton Growing Association and the Empire Cotton Growing Corporation. Mention was also made of good work of the Advisory Committee in England. The cotton cess collected in the islands had proved adequate to meet the expenses of the Association. The high cost of Sea Island cotton resulted in a considerable number of bales being unsold at the end of the year, and it was stressed that if the trade built up during the past three or four years is to survive, the cotton must be made available at a considerably lower figure. A scheme was passed for the organization of the cotton breeding station in Montserrat as a central cotton breeding station for all the islands. Mr. F. A. Squire, entomologist for cotton pest investigation in the Windward and Leeward Islands, gave an account of his investigations on the control of cotton pests.

244. Barbados: *Cotton Industry,* 1936-37. (*Agr. J. of Dpt. of Sci. and Agr., Barbados,* vi., 2, 1937.) Cotton seed sufficient to plant 153 acres was issued. Germination was excellent, and the plants commenced to boll well. Unfortunately damage from pink bollworm and cotton leaf worm resulted in a materially decreased yield. It was felt that to assist in controlling pink bollworm a longer close season should be proclaimed; this has been done, and the next close season will last for a period of about eighteen months. During the season progeny row work was continued at Codrington Experiment Station with eight selections

of Barbados Sea Island and St. Vincent 135. As in the past few seasons, selections from Barbados P.170 (strains P.170-2 and P.170-4) proved the most superior, and compared favourably with St. Vincent 135. Selfed seed of the two strains has been retained for multiplication and further progeny row work. To secure the introduction of only healthy material into the island, the holds of seventeen ships were fumigated with Zyklon B and 7,822 bags of imported cotton seed were disinfected by means of the Simon's Heater.

245. St. Vincent: *Cotton Industry*, 1937-38. A note on the cotton crop for the quarter ended September 30 last, received from the Acting Superintendent of Agriculture, is to the effect that the dry season of 1937 was unusually prolonged, and the total rainfall for August and September was rather less than 65 per cent. of the average. Germination on the whole was quite fair, but subsequent growth suffered, especially in the leeward districts where much supplying, and in some cases replanting, was necessary, but surprisingly good stands were obtained on the windward side. There was a marked reduction in the incidence of angular leafspot disease, and plants presented a clean, healthy appearance, probably due to the mercuric chloride treatment of the seed, which was omitted in the previous year. Owing to the severe weather conditions growers were unable to plant as large an area as they had hoped, the total acreage being 4,500 acres compared with 5,294 acres in the 1936-37 season.

246. *Cotton Progress*, 1937-38. (*W. Ind. Comm. Circ.*, lii., **1024**, 1937, p. 522.) The Acting Superintendent of Agriculture reported in December that the cotton plants were making good progress and presented a clean and healthy appearance. The results of the combined variety and manurial trials with the Montserrat and St. Vincent strains have now been statistically examined, and it has been concluded that the Montserrat strain possesses a great advantage because of its superior ginning percentage.

COTTON IN THE UNITED STATES.

247. Visit to the U.S. Cotton Belt, 1937: The Irrigated Cotton Areas of America. By N. S. Pearse. (*Int. Cott. Bull.*, xvi., **61**, 1937, p. 54.) Four of the thirty-eight new irrigation projects are located in the Cotton Belt, from New Mexico to California. In the latter State cotton (Acala) is grown under the one variety rule. Details, which make interesting reading, are given of the work of cotton irrigation, the grade and staple of cotton produced, and the prospects for cotton in the State. The other more eastern States are then dealt with in the same way. The report also discusses such matters as false packing and the issue of a new marking system for cotton bales; improvement of cotton quality; one variety cotton communities; the rehabilitation of Sea Island cotton in Florida; and the proper definition of the terms "naps," "neps," and "motes." Several illustrations are included in the report.

248. The American Cotton Loan and Subsidy Plan. (*Int. Cott. Bull.*, xvi., **61**, 1937, p. 96.) Farmers who agreed to co-operate in a crop reduction programme on cotton for 1938 were made eligible for a loan and price adjustment payment on 65 per cent. of their production from their base acreage, whether they were in the Soil Conservation Programme or not. The maximum loan will be: 9 cents per lb. on $\frac{7}{8}$-inch middling cotton and better; 8 cents on $\frac{13}{16}$-inch middling and better; $7\frac{3}{4}$ cents per lb. on $\frac{7}{8}$-inch cotton below middling in grade; no provision has been made for loans on cotton of below middling grades of $\frac{13}{16}$-inch. Loans were made available on or before September 15, 1937, and mature July 31, 1938. The maximum price adjustment is to be 3 cents per lb. on

65 per cent. of the base (more of base if money available), and all adjustments are based on the price of cotton at the ten designated spot markets on the day of sale. Farmers must keep correct records of weight, tag numbers, location of cotton and grade of cotton, date of sale, etc., in order to secure the price adjustment payment.

249. MOISTURE IN AMERICAN COTTON. (*Int. Cott. Bull.*, xvi., **61**, 1937, p. 104.) A bale of cotton changes in weight, due to loss or gain in moisture, when moved from one place to another according to conditions of atmospheric humidity. American mills are accustomed to allow for this change in weight, which they know will occur, and pay on their own weighings of the cotton and not on the weights of the shipper at the point of origin.

250. COTTON PRICES IN RELATION TO COTTON CLASSIFICATION SERVICE AND TO QUALITY IMPROVEMENT. By L. D. Howell and J. F. Hembree. (*U.S. Dpt. Agr., Bur. Agr. Econ.*, 1937. From *Exp. Sta. Rec.*, 77, **4**, 1937, p. 557.) The relation between average prices and average grade and staple length from market to market and from one period to another, the factors affecting grade and staple premiums and discounts, the influence of prices to growers on quality of cotton produced, and means of making desirable adjustments in the quality of cotton produced, are discussed.

251. SEA ISLAND COTTON. By W. E. Stokes. (*Press Bull. No.* 500, Univ. of Florida, 1937.) Brief directions are given to cultivators. Pure seed is necessary, also early poisoning for bollweevil, careful cultivation, picking, and ginning.

252. SEA ISLAND COTTON RESEARCH. (*U.S. Yearbook of Agr.*, 1937. From *W. Ind. Comm. Circ.*, lii., **1020**, 1937, p. 441.) Attempts have been made to re-establish the Sea Island cotton industry in Florida, and experiments have been carried out to obtain more prolific strains of Sea Island or to produce a substitute by hybridizing this cotton with outstanding long-staple Upland varieties. Some 8,000 hybrids were made in 1935, and many of these are being back-crossed to one or both parents in the hope of establishing pure strains having the desired combinations of fibre quality and plant characteristics. Improved strains of Meade, an early Upland variety, with fibre similar to Sea Island in length and quality, are also being developed with the object of obtaining extra-staple cottons adapted for production in the south-eastern States.

253. LANDLORD AND TENANT ON THE COTTON PLANTATION. By T. J. Woofter. (*Works Prog. Admin. U.S. Div. Soc. Res., Res. Monog.* **5**, 1936. From *Exp. Sta. Rec.*, 77, **2**, 1937, p. 268.) Large-scale cash-crop farming continues to-day in the areas of the south-east that had large slave holdings and large cotton plantations in 1860. The negro or the white tenant farmer operates most of the plantation land. Concentration on cotton increased from the Civil War until the boll-weevil invasion soon after 1910. Since 1910 there has been a marked shift of the cotton acreage to Texas and Oklahoma, the combined acreage of these States having increased 100 per cent. from 1910 to 1930; Alabama, Georgia, North Carolina and South Carolina had 5 per cent. less acreage in cotton in 1930 than in 1910. Up to the inauguration of the cotton reduction programme, the plantations of the South tended to be less and less self-supporting. Between 1933 and 1935 probably more crop diversification was undertaken than during any other period of the South's history. Although exclusive cotton culture results in heavy losses in bad years, the owners of large tracts still concentrate on this crop because no other use of large-scale tracts is so profitable to the landlord in good years.

Nearly half of the landlords interviewed for this study had long-term debts

mostly in the form of mortgages, averaging more than 40 per cent. of the apprized value of their land, buildings, animals and machinery. These debts were incurred to meet deficits or purchases of machinery, etc. The long-term debts of tenants are usually contracted with or through the landlord, and are either secured by chattel mortgage on livestock or equipment, or simply carried forward on the landlord's books and added to current borrowing as a lien against future production. The tenant's short-term debts for the current season are usually incurred with the landlord, who provides the tenant's share of expenses and his subsistence advances during the crop season, charging them against future production. Sometimes the merchant makes the subsistence advances. The average time for which advances were made, as shown by this survey, was seven months, and the average advance was $12.80 per family per month.

The landlord's net income in 1934 was sufficient to pay him 6 per cent. on his invested capital and about $850 for his labour income. The average net income per family of the wage hands, croppers, share tenants, and renters on plantations in the eleven areas surveyed was only $309, or $73 per capita.

254. King Cotton Shares His Throne. By M. A. Rose. (*Scribner's Magazine*, October, 1937.) The value of the southern forests of the United States as sources of paper has been discovered, and there is a boom in paper-making. A rush southwards is going on, and already £20,000,000 have been invested in new mills. The bearings of all this upon cotton will be considerable.

255. Alabama: *Quality of Cotton Ginned: Crops of* 1928-36. By W. B. Lanham *et al.* (*U.S. Dpt. of Agr., Bur. of Agr. Econ.*, June, 1936.) During the period under review a greater proportion of the cotton ginned in Alabama was extra white middling and above and white middling and above in grade than all the Upland cotton ginned in the United States. An average of only 2·7 per cent. of ginnings in Alabama was 1 inch and longer in staple, whereas an average of 26·2 per cent. of all Upland cotton ginned in the United States was 1 inch and longer in staple. In spite of the fact that Alabama cotton is largely of the shorter staple lengths, there has been improvement in recent years and efforts to encourage the planting of longer staple varieties of cotton are meeting with noticeable success.

256. *Cotton Spacing.* (*Alabama Sta. Circ.* 76, 1937. From *Exp. Sta. Rec.*, 77, 3, 1937, p. 329.) Spacing experiments with cotton, 1924-35, led to the recommendation of 18 inches apart in the drill with from 1 to 3 plants per hill. Row widths with liberal fertilization may vary from 2·5 to 4·5 feet, while under low fertility conditions or with only moderate fertilizer applications row width should not exceed 3·5 feet. Of the two factors which were affected by variations in spacing, yield was influenced by variations in row width, distance between hills, and in number of plants per hill (largest yields coming from spacings giving from 8,000 to 25,000 plants per acre), and boll size was increased by wide spacings and decreased by close spacings. The optimum spacing was about the same on the different soil types on which the experiments were conducted.

257. Georgia: *Cotton Experiments*, 1936-37. (*49th Ann. Rpt. Exp. Sta. Ga.*, 1936-37.) In North Georgia the highest values per acre were obtained with Stoneville and D. and P.L. 11 varieties. In South Georgia, Stoneville 2B was again the leading variety in value per acre, but the strains Rhyne's Cook, Cook 12-142, and Rhyne's Clevewilt were the most resistant to wilt disease. Breeding work with Stoneville No. 2 was continued at the Experiment Station, and several hundred new plant selections were made, many of which had uniform fibre of $1\frac{1}{16}$ to $1\frac{1}{8}$ inches in length, and a lint outturn above 40 per cent.

Investigations on cotton wilt disease were continued, and in order to

determine the extent of the losses a survey of cotton fields was made in eight counties of the Coastal Plains area. Wilt was found prevalent in 95 per cent. of the farms visited. The estimated loss to farmers in this region was 57,684 bales, of a value of $4,500,000.

258. Mississippi: *Quality of Cotton Ginned, Crops of* 1928-34. By W. B. Lanham *et al.* (*U.S. Dpt. Agr., Bur. Agr. Econ.*, 1937. From *Exp. Sta. Rec.*, 77, **5**, 1937, p. 719.) For the six-year period an average of nearly 79 per cent. of the Mississippi cotton crop was extra white, white middling, or above in grade as compared with 68 per cent. of the Upland cotton crops of the United States. The average staple length was 16·7 sixteenths inch for Mississippi and 15·32 sixteenths inch for the United States. The proportion of ginnings in Mississippi grading extra white and white middling and above decreased, and the proportion of $\frac{15}{16}$ inch and shorter staple also decreased as the season advanced.

259. Missouri: *Good Varieties of Cotton for Missouri.* By B. M. King. (*Miss. Sta. Circ.* 194, 1937. From *Exp. Sta. Rec.*, 77, **4**, 1937, p. 477.) Over a wide range of soil conditions the best varieties are Delta and Pine Land (Deltapine) 11 and 11A, Stoneville 5 and 5A; for very fertile soils, where wilt and rust are not serious, Stoneville 4A (Ambassador); for sandy soils where wilt and rust occur, Arkansas Rowden 40.

260. North Carolina: *Important Factors in Cotton Growing.* By P. H. Kime. (*N. Car. Sta. Agron. Inform. Circ.* 106, 1937. From *Exp. Sta. Rec.*, 77, **3**, 1937. p. 327.) The factors discussed include soils and their preparation, varieties, planting and spacing, cultivation, picking, storage, ginning, and handling of planting seed.

261. *Results of Cotton Variety Experiments,* 1931-36. By P. H. Kime. (*N. Car. Sta. Agr. Inform. Circ.* 105, 1937. From *Exp. Sta. Rec.*, 77, **3**, 1937, p. 327.) Coker, Foster, and Farm Relief cottons were found best for heavy and poorly drained soils, and Dixie Triumph, Clevewilt, and Dixie for wilt-infested soils in North Carolina.

262. Tennessee: *Cotton Varieties Grown by Tennessee Farmers, with Regional Comparisons.* By C. E. Allred *et al.* (*Tenn. Sta. Agr. Econ. and Rural Soc. Dpt. Monog.* 35, 1937. From *Exp. Sta. Rec.*, 77, **4**, 1937, p. 477.) The varieties grown per county, ginnings of different varieties, predominant varieties in different counties and geographic districts, the mixing of seed in ginning, renewal of seed supply, improvement of varieties, etc., are discussed.

263. Texas: *Quality of Texas Cotton Crops of* 1928-35. By W. B. Lanham *et al.* (*U.S. Dpt. of Agr., Bur. of Agr. Econ.*, March, 1937.) Discusses the economic importance of cotton in Texas; soil types and climatic conditions; cotton prices as related to quality; grade and staple length of cotton produced in Texas and in the United States.

Texas produces about one-third of the entire cotton of the United States, but the average length of staple is shorter than for the United States as a whole. The grade of cotton produced in Texas is, in general, fairly uniform.

COTTON IN EGYPT.

264. Egypt: Review of the 1936-37 Cotton Season. (*Egyptian Cott. Year Book*, 1936-37, p. 13.) Conditions during the growing period were more favourable than usual; leafworm attacks were less severe, and the Government measures to control this pest were efficiently applied. The water supply was ample for all requirements, the only drawback to an otherwise perfect condition

being the intense heat, which caused premature ripening of the first bolls in many parts of Upper and Middle Egypt, to the detriment of staple and grade of the first picking. The Delta was not affected by this heat-wave and produced a record crop. The crop matured early, and the total production amounted to 8,846,133 kantars. Owing to good demand and higher prices growers were willing sellers, and cotton was moved to market as soon as available. Local consumption amounted to 58,000 bales. The history of markets during the season is fully described.

265. THE EGYPTIAN COTTON YEAR BOOK, 1936-37. We have received a copy of the sixth edition of this publication. In addition to numerous tables of statistics and acreage, production, stocks, prices, consumption, exports, etc., it contains the following among other short articles: "A Review of the 1936-37 Cotton Season"; "The Problems of Soil and Variety" (C. H. Brown); "The Egyptian Section of the Lancashire Cotton Industry" (D. Windel); "The Egyptian Section of the Cotton Industry on the Continent of Europe" (G. Pettenpaul); "The Egyptian Cotton Market in America" (W. K. Shaw); "S×P Cotton in Comparison with Pima"; "Three Years' Experience of the Anti-Mixing Law in Egypt" (P. J. Philippou).

266. THE SAKEL SUBSTITUTES: WHAT IS BEING DONE IN EGYPT. By H. E. Fouad Abaza Pasha. (*Text. Wkly.* 11/2/38, p. 183.) The history of Sakel covers the years from 1910, its zenith being in 1922, when 77 per cent. of the Egyptian cotton area was covered with it. Fifteen years later the figure was only 5 per cent., the fall being due largely to its susceptibility to wilt. The bulk of to-day's Sakel is of deteriorated quality, though it can be produced as well as ever. There is a tendency to replace it by cottons of shorter staple, but the writer considers that this should not be allowed to happen. A substitute should possess good staple, high yield, and adaptability to growth in various parts of Lower Egypt, and most varieties hitherto tried have fallen short in one or other of these essentials. Sakha 4 is weaker, Giza 26—the latest variety—suffers badly from wilt, Maarad is not suitable to many districts. It is hoped however, that ere long a real and satisfactory substitute for Sakel may be evolved.

267. LONG-STAPLE COTTONS IN EGYPT. By M. A. Fikry. (*Bull. No.* 33, *Tech. Sect. Roy. Agr. Soc. Egypt*, 1937.) An analytical survey of the present state of Egyptian cottons, showing how they have, in recent years, lost appreciably in length, strength, and fineness, and, on the other hand, improved in production. This is the result of the gradual decline in the cultivation of Sakellaridis and its displacement by other cottons, mainly Ashmouni and Giza varieties, at present of inferior staple quality, but of higher yield. It is stressed that Egypt should spare no effort to produce a satisfactory substitute for Sakel, with good lint, high yield, and adaptability to growth in several localities in Lower Egypt.

268. GIZA 7 COTTON. (*The Economist*, 4/12/37.) An historical account of the extension of this variety, which was derived from Ashmouni about 1921. The acreage, equal to that of Sakel in 1935, is now three times that of the latter. Although not quite equal to Sakel in quality, it gives 35-40 per cent. greater yield. There are already indications, however, that later varieties may in turn replace it.

269. EXPERIMENTAL AND STATISTICAL TECHNIQUE OF SOME COMPLEX COTTON EXPERIMENTS IN EGYPT. By F. Crowther and M. S. Bartlett. (*Emp. J. of Exp. Agr.*, vi., 21, 1938, p. 53.) The experimental and statistical technique used in a series of complex cotton experiments carried out in Egypt during

1934-36 is discussed in relation both to the objects of the research programme and to the particular conditions determining field experimentation on the cotton crop in Egypt. Statistical aspects of the results considered include figures on the relative accuracy of main and sub-plot, or of partially confounded to completely randomized layouts, and the correction for damage due to salt accumulation in the upper layers of the soil for three of the 1936 experiments. The variation in fertility throughout the site in three representative experiments is illustrated. The exact type of layout decided on is necessarily a problem demanding some deliberation, depending both on practical and theoretical considerations. No layout, however, will eliminate extreme patchiness, and the need for care in the choice of an experimental site is, of course, not to be neglected.

COTTON IN OTHER FOREIGN COUNTRIES.

270. Argentina: *Cotton Industry*, 1936-38. (*S. Amer. Jour.*, 15/1/38.) A substantial fall in cotton production during 1936-37 is ascribed to the drought; the total yield was 31,170 tons compared with 80,057 tons in the previous season. The lowest fibre yield (27·1 per cent.) was registered in the Chaco. The area planted to cotton for the 1937-38 season is given as 477,900 hectares, an increase of 67,000 hectares over the 1936-37 season.

271. *Boletin Informativo.* (Pubd. by Min. of Agr., Junta Nacional del Algodon, Buenos Aires, Argentina, 1937.) Numbers 28, 29, 30 and 32 of this publication contain articles (in Spanish) and statistical tables relating to areas, yields, and prices of crops, not only in Argentina, but in the United States and other countries. In No. 28 the area under cotton in Argentina in 1937-38 is expected to reach 536,000 hectares. The exports from February to July, 1937, amounted to 108,294 kilos, compared with 265,456 kilos during the same period in 1936. An account is given in No. 30 and subsequent issues of the principal associations in the United States concerned with the improvement of cotton seed and of cotton cultivation.

272. *El Algodon Factor Importante en la Historia de Catamarca, Argentina.* By C. S. Oviedo. (*Bull. No.* 24, Min. de Agr. Buenos Aires, Argentina, 1937.) A brief account of the cotton industry in Catamarca, where the earliest traces of the industry in Argentina can be found. The district is of much historical interest.

273. Belgian Congo: *Comité Cotonnier Congolais. Bulletin No.* 7, 1937, contains the following among other articles: "Comment utiliser les ressources des Caisses Administratives des Chefferies" (A. de Bauw); "La fête du coton" (A. Ravet); "Considérations sur l'utilisation et l'entretien des peignes des égreneuses" (M. Pilette). *Bulletin No.* 8, 1938, includes the following articles: "Quelques particularités de l'activité cotonnière au Congo Belge" (A. Landeghem); "Le Shedding" (A. Brixhe); "L'Alimentation des égreneuses" (M. Pilette).

Notes on cotton in the Belgian Congo, legislation, marketing, etc., are included.

274. *La culture cotonnière en Oubangui-Chari, A.E.F., et au Congo-Ubangi, Congo Belge.* By W. J. Lugard. (*Bull. No.* 28. Ass. Cotonn. Coloniale, October, 1937, p. 100.) The cultivation of cotton in these two districts is progressing rapidly and with almost equal speed. One region is French, the other Belgian, and the writer draws attention to the similarities of treatment.

275. Association Cotonnière Coloniale. *Bull. No.* 28, 1937, contains the following among other articles: "L'Algérie et le coton"; "Le coton

africain"; "La production cotonnière de nos territoires d'outre-mer"; "Le coton en Iran"; "Une récolte américaine en coton de 15½ millions de balles; le coton colonial français" (E. Charles-Pierre). The usual notes on cotton in the French colonies and other countries, cotton legislation, marketing notes on current literature, etc., are included.

276. BRAZIL: *Moco Cotton in Brazil.* By W. C. de Souza. (*Revista Textil*, vi., 4, 1936. From *Summ. of Curr. Lit.*, xvii., 24, 1937, p. 725.) Moco is the best of the different species of cotton native to Brazil, having a staple of 30 mm. The trees grow to a height of 2·5 to 4 metres and live 24 to 26 years. They are found in Ceara, North Rio Grande and Parahyba. Many hybrid types exist, a special type being found near the nitre fields. In the Brazilian market the quality and quantity of Moco are said to be decreasing. The author reviews work done on the improvement of native cotton in certain experimental stations which have had to be closed, with special reference to the work of Pollard in Ceara. It is in the north and north-east of the country that the problem of improving cotton needs to be investigated.

277. CHINA: *Cotton Industry*, 1937. (*Int. Cott. Bull.*, xvi., 61, 1937, p. 43.) The China Cotton Statistical Association estimates that production will reach 4,335,000 bales of 500 lb. The increase is primarily the result of acreage expansion in North China.

278. *Agricultural Research in China.* By R. M. Datta. (*Curr. Sci.*, 6, 1937, p. 36. From *Pl. Bre. Absts.*, viii., 2, 1938, p. 94.) Selection from local forms, hybridization and variety tests are conducted in connection with the improvement of cotton.

279. GREECE: *Cotton Industry.* (*Rpt. of the Hellenic Cott. Inst.*, 18/1/38.) Describes briefly the climate and soils of Greece, the organization of the cotton industry since 1931, and the progress resulting from the establishment of the Cotton Institute. In 1931 production amounted to 9,889,700 kilos; the latest estimate for the 1937 crop is 63,146,000 kilos. Many new varieties of cotton have been introduced into the country, and those most in request are Acala and Ingold.

280. *Cotton Production in Greece.* By C. Soulioti. (*Egyptian Cott. Year Book*, 1936-37, p. 121.) A record of the successful work accomplished by the Cotton Board established in Greece some five years ago. In 1932, 43,000 acres were cultivated in cotton, yielding 3½ million kilograms of lint, whilst in 1937, 220,000 acres were planted, the total yield amounting to 23,000,000 kilograms of lint.

281. ITALY: *Cotton Cultivation.* (*Textilia*, 15, 1936, p. 464. From *Summ. of Curr. Lit.*, xviii., 2, 1938, p. 28). An account of cotton growing in Southern Italy, Sicily, and Italian possessions in Africa, with the names of the cottons and the quantities produced.

282. *Italian Cottons: Characteristics.* By R. Riso and C. Levi. (*Boll. della Coton*, 31, 1936, p. 596. From *Summ. of Curr. Lit.*, xviii., 1, 1938, p. 15.) Counts, effective and preponderating lengths, dispersions, short-fibre contents, convolutions, breaking loads, lengths and extensions, moisture regains, and ash, fat and wax, and total nitrogen contents are tabulated for samples of Acala cotton grown in Sicily and are compared with the original American cotton from which the Italian strains were derived. It is pointed out that the lower quality of the samples grown in Italy is largely due to unsatisfactory conditions of cultivation and ginning, which could easily be remedied. The characteristics of Biancavilla, Biancorizza, Bate's Big Boll and Nostrale di Sciaccio cottons grown in Italy are also tabulated and discussed. When compared with a Strict Middling

$1\frac{1}{16}$-inch cotton, the Italian Acala cotton is found to be of superior quality, and the Italian Biancavilla and Bate's Big Boll are found to be comparable with the American product. The Biancorizza and Nostrale di Sciaccio varieties are of poorer quality. The characteristics of samples of the Egyptian cottons, Giza 3 and Ashmouni, and the American varieties Rowden, Stoneville, and Mebane, grown in the botanical gardens of the University of Palermo, are briefly discussed.

283. MANCHURIA: *Cotton Industry.* We have received from the Department of Overseas Trade a copy of the new laws relating to cotton production in Manchuria. As at present conducted, cotton cultivation is a primitive and speculative occupation. It attracts the peasants in certain localities because, although the risk of damage to crops by flood or drought is great, very large profits may be earned in a good year. The new regulations, by their complicated nature and the powers of control accorded to local authorities and the agricultural associations, are scarcely likely to make the industry more popular with the peasants.

284. PARAGUAY: *Cotton Production.* (*Wirtschaftsdienst*, **22**, 1937, p. 1494. From *Summ. of Curr. Lit.*, xxvi., **22**, 1937, p. 672.) The economic position of Paraguay is reviewed. Recovery in exports since the Chaco war is largely due to a record cotton harvest; this season it has reached about 15,000 tons, against 5,600 in the previous year, and the quality is exceptionally good.

285. PERU: *Memoria de la Junta Directiva de la Sociedad Nacional Agraria*, 1936. (Pubd. Lima, Peru, 1937.) *Cotton Industry*, 1936. The cotton crop reached the record figure of 85,175 tons, an increase of 15 per cent. over the previous season. Prices were rather lower in 1935-36. Special regulations were enforced with a view to combating the damage caused by cotton pests in various cotton localities.

286. *Peruvian Cotton Production and Distribution.* By M. Bernales. (*Egyptian Cotton Year Book*, 1936-37, p. 63.) Cotton is the chief cash crop of the country, and its production is mainly in Peruvian hands, so that its profits are locally used. The area is about 400,000 acres. Wilt and stainer are the chief pests. The plant is ratooned for some years. Details are given of cultivation under the peculiar conditions that exist in Peru.

287. PORTUGUESE COLONIES: *Les Progrès de la Production du Coton.* By C. de Mello Geraldes. (*Coton et Cult. Coton.*, xi., **2**, 1937, p. 103.) The general organization of the cotton industry is upon the same lines as that in the Belgian Congo.

288. TURKEY: *Cotton Cultivation*, 1937. A report from the Dept. of Overseas Trade is to the effect that owing to unseasonable weather production in the Ægean zone will not exceed 65,000 bales. The crop of the new variety named "Akala," evolved by the Cotton Research Institute at Nazilli, is estimated at 20,000 bales.

289. *Turkish Cotton Industry: Development.* (*Wirtschaftsdienst*, **22**, 1937, p. 1312. From *Summ. of Curr. Lit.*, xvii., **23**, 1937, p. 724.) References are made to new developments in cotton mills in Turkey, largely controlled by banking interests and supplied with German machinery. The capacity of the mills is sufficient to meet about 80 per cent. of home consumption. In spite of this there does not appear to be any prospect of a diminution in the amount of Turkish raw cotton available for export. Last year the production was about 40,000 tons, and home consumption at least 16,000 tons.

SOILS AND MANURES.

290. THE NATURE AND PROPERTIES OF SOILS. By T. L. Lyon and H. O. Buckman. (New York, Macmillan Co., 1937. From *Exp. Sta. Rec.*, 77, **5**, 1937, p. 587.) The contents are: A fundamental concept of the soil; the supply and availability of plant nutrients in mineral soils; the physical properties of mineral soils; colloidal clay and ionic exchange; the organisms of the soil; the organic matter of mineral soils; forms of soil water and their plant relations; soil-moisture losses and their control; the origin and classification of soil materials; soil formation, classification, and survey; the nature and utilization of organic soils; the soil reaction—soil acidity and alkalinity; liming the soil; the nitrogen economy of soils; fertilizers and fertilizer practice; farm manure and green manure; the methods of fertility maintenance for mineral soils; author index; and subject index.

291. A STUDY IN SOIL CULTIVATION: THE EFFECTS OF VARYING SOIL CONSOLIDATION ON GROWTH AND DEVELOPMENT OF RAIN-GROWN COTTON. By O. V. S. Heath. (Reprinted from *J. Agr. Sci.*, xxvii., **4**, 1937, p. 511.) Experiments were carried out in four seasons at Barberton, South Africa, occupying approximately 2¼ acres of ground. Three soil treatments were used—viz., Normal (*N*), Compressed (*C*), and Grubbed (loosened) (*G*). Measures of consolidation of the soil were made with a specially designed apparatus, and large differences established. Estimations of water content and nitrate content were carried out. No great differences were found. Fortnightly samples of the plants were taken, from which numerical data were collected designed to estimate morphological development. Derived data on net assimilation rate, relative leaf-growth rate, and efficiency index were calculated. Growth in total dry weight was found to conform approximately with an exponential law up to the time of flowering. Up to this stage also net assimilation rate was found to remain constant. Growth differences between treatments were related to variation in net assimilation rate only. The results were analyzed statistically. Significant results alone are emphasized. In all respects growth and development on the consolidated soil was more rapid than that on the grubbed soil, normal being generally intermediate. The results are discussed with reference to the question of nitrogen supply, water supply, and aeration of the soil.

292. BROAD RELATIONSHIPS BETWEEN MICRO-ORGANISMS AND SOIL FERTILITY. By J. G. Lipman. (3rd Int. Cong. Soil Sci., Oxford, 1935. From *Exp. Sta. Rec.*, 77, **3**, 1937, p. 307.) Recent progress in soil microbiology is reviewed, with citations of more than 130 papers. The discussion is concerned with recent observations on soil micro-organisms, methods, environmental conditions (including temperature, the nature and concentration of the salts present, moisture, reaction, aeration and organic matter), and interrelations between higher plants and micro-organisms (including antibiotic phenomena, associations of legumes and non-leguminous plants, and plant stimulants and accessory food substances).

293. THE FORMATION OF NITRITE BY HETEROTROPHIC BACTERIA FROM SOIL. By L. M. Crump. (3rd Intern. Cong. Soil Sci., 1935. From *Exp. Sta. Rec.*, 77, **3**, 1937, p. 307.) The author finds that " there are a relatively large number of heterotrophic soil bacteria which under very varied conditions produce nitrite in small amounts from ammonia. These forms require organic matter for their satisfactory growth and carry out their chemical transformations at pH values anywhere between 5·0 and 8·0. As yet there is no evidence of different morphological stages in the course of the life cycle, and the great majority

are short rods or cocci. There is also no indication that in any other respect do they fall into any one physiological grouping. To some extent a correlation can be traced between the increase in their numbers in a culture and the increase of nitrite, but this breaks down in the case of those organisms that utilize nitrite in the course of growth."

294. The Dilatometer Method for Determining the Moisture Equivalent of Soils. By G. J. Bouyoucos. (*Soil Sci.*, 43, **5**, 1937. From *Exp. Sta. Rec.*, 78, **1**, 1938, p. 16.) Experimental results support the conclusion that the dilatometer method " possesses the following advantages: it is comparatively free from the influence of external factors and is consequently less empirical, and the results are on a more nearly absolute basis: it makes two important determinations at the same time—the moisture equivalent and the wilting point; it is rapid and simple; the apparatus required is simple and inexpensive."

295. The Geological Background of Soil Erosion. By W. R. Browne. (*J. of the Aust. Inst. of Agr. Sci.*, iii., **3**, 1937, p. 142.) Pointing out that erosion is a geological process, and that there could be no rich delta lands or flood plains without it. Unfortunately man has greatly accelerated the process, and the very best of scientific knowledge and skill—geological, botanical and pedological —must be brought to bear on the problem to prevent soil erosion becoming a very serious danger.

296. Soil Erosion in the Colonial Empire. By Sir Frank Stockdale. (*Emp. Jour. of Exp. Agr.*, v., **20**, 1937, p. 281.) A review of the position in regard to soil erosion in the Colonial Empire, describing the measures which are being taken to check and control its effects, and indicating where further efforts are required. East Africa shows the most serious losses, especially Kenya, where the condition of some of the Native Reserves is becoming serious and deterioration is proceeding apace. Untutored agricultural operations, and overstocking—with consequent overgrazing—are the main causes of erosion. The problem of control must be approached from various angles. Physical, biological, and social factors have to be considered, and there must be the fullest co-operation between the administrative and technical departments. Generalization as to control measures must be avoided, and working plans evolved for each area after it has been examined. Vegetation control is the most important method for controlling soil erosion, since it produces a cure by natural methods and is much less expensive than treatment by mechanical means. In cultivated lands on hilly slopes, however, contour ridges, terraces, hedges and drains are necessary when strip cropping cannot be adopted. All expenditure on anti-erosion measures should be matched with expenditure of a similar magnitude for agricultural education, demonstration and propaganda, if the future is to be secured.

297. The Conservation of the Soil. By W. C. Lester-Smith. (*Trop. Agr.*, Ceylon, lxxxix., **3**, 1937, p. 167.) A popular and very clear account of the evil effects of soil erosion in Ceylon and of the soil conservation measures which are proving most effective in control.

298. Soil Erosion in the U.S.A. (*Nature*, cxl., **3546**, 1937, p. 687. From *Trop. Agr.*, xiv., **12**, 1937, p. 355.) A recent note in *Nature*, referring to an illustrated article in the *Geographical Magazine*, states that more than 10 per cent. of the total land area of the United States has lost more than three-quarters of its top soil, and that a further 30 per cent. can be regarded as moderately eroded. In the Mississippi valley alone 400,000,000 tons of good rich top-soil

are swept annually into the Gulf of Mexico, and in that area 25 per cent. of the cultivated land has been stripped down to the subsoil and rendered useless for cultivation. A reduced yield of crops is the first sign of soil erosion, and this is generally countered by the use of fertilizers, which are, however, only a temporary remedy. A change in agricultural practice is required, and this is being carried out in some areas. Terracing, strip cropping, embankments along contours, and other devices are being used, but most important of all is the reversal from one-crop cultivation to crop rotation and mixed farming. This, of course, will reduce the output of cash crops and mean a greater production of livestock products. The tendency will be to put American agriculture on a basis of home food production rather than intensive export production.

299. THE DUST BOWL CAN BE SAVED. By B. Hibbs. (*Saty. Eveng. Post*, New York.) The writer paid a second visit to the "Dust Bowl," the great area covered by dust two years ago in the United States. The experimental farm of 900 acres is proving successful, and millets and other crops are gradually turning the country once more green, and checking the blowing away of the soil.

300. PRELIMINARY NOTES ON THE USE OF ELEPHANT GRASS AS A FALLOW CROP IN BUGANDA (UGANDA). By G. W. Nye. (*E. Afr. Agr. Jour.*, iii., **3**, 1937, p. 186.) Elephant grass is looked upon as an almost perfect regenerator of the soil, and it is all but impossible for other weeds to live under it. Couch grass is an exception; it does not spread under elephant grass, but remains dormant until such time as the land is opened up again. The mass of stems and root stocks of elephant grass form a complete protection against soil erosion for at least a year after the land is reopened. The objections to its use are the labour of planting and the labour of clearing.

301. EFFECT OF FARMYARD MANURE ON FIBRE CHARACTERS OF COTTON. By H. R. Nayak. (*Ind. J. Agr. Sci.*, vii., **6**, 1937, p. 877.) Experiments carried out over three seasons indicated that the optimum conditions for the improvement of quality in cotton were obtained when five tons of farmyard manure were applied to *jowar*, which was the previous crop.

302. FERTILIZER EXPERIMENTS WITH COTTON ON HEAVY IRRIGATED SOILS. By G. Staten and D. A. Hinkle. (*New Mexico Sta. Bull.*, 248, 1937. From *Exp. Sta. Rec.*, 77, **6**, 1937, p. 778.) Eight years' continuous cotton caused no reduction in yield. Higher yields were obtained from manured plots than from those treated with superphosphate, ammonium sulphate or potassium sulphate. No fertilizer treatment used affected the prevalence of wilt.

303. ADAPTING HIGH ANALYSIS AND CONCENTRATED FERTILIZERS TO COTTON SOILS. By J. J. Skinner *et al.* (*Soil Sci.*, 44, **1**, 1937. From *Exp. Sta. Rec.*, 77, **6**, 1937, p. 778.) Experiments to determine the factors influencing the effects of concentrated fertilizers on cotton, and to compare different concentrated fertilizers with standard strength mixtures, were conducted by the U.S. Dept. of Agriculture, Bureau of Plant Industry, 1925-36, in co-operation with experiment stations in North and South Carolina, Virginia and Georgia. "The results as a whole indicated that differences in content of minor elements are unimportant in their influence on the relative efficiency of standard and concentrated fertilizers. The nitrogen sources did not vary widely in effects on cotton when the fertilizers were properly supplemented with limestone. The largest yields generally were obtained with concentrated fertilizers containing acid-forming ammonia salts or soluble nitrogen supplemented with limestone."

304. COMPOST. By S. D. Timson. (*Rhod. Agr. J.*, November, 1937, p. 851.) The various sections of this paper deal with: Technique of composting; the process

of rotting; composting the sunnhemp green-manure crop; the micro-organic population of the soil; the place of compost in Rhodesian agriculture. In an appendix descriptions and illustrations are given of three types of labour-saving implements for composting: the Hosier hay sweep, home-made ox-drawn hay sweep, and a hay drag.

305. COMPOST-MAKING WITHOUT WATERING. By C. R. Tofte. (*E. Afr. Agr. Jour.*, iii., **3**, 1937, p. 171.) This article describes the final technique, evolved after several months of experiments, for preparing large quantities of compost simply and cheaply from a single material, Napier grass (*Pennisetum purpureum*), with the aid of twenty-eight head of cattle. The conditions did not allow of artificial watering. At least 1,200 tons of a compost, with the important quality of good division, are made yearly. On the average the material is in the stack ninety days.

306. A NOTE ON COMPOSTING ORGANIC MATTER BY THE USE OF CHEMICAL STARTERS. By V. V. Gadkil. (*Agr. and Livestock in India*, vii., **6**, 1937, p. 711.) In the absence of cattle, organic wastes can be composted very effectively by ammonium sulphate (0·3 per cent.) with calcium arsenate (5 per cent.). The material must be well mixed with a solution of these two starters and heaped above ground under shade. The heap must be raked and watered at intervals of eight to ten days; aeration must be good and moisture content should be maintained at 60/70 per cent. Fermentation should be complete in about ninety days, and the manure ready for application to the soil.

307. RESPONSES FROM VARIOUS SOURCES OF NITROGEN FERTILITY. By W. R. Paden. (*South Car. Sta. Bull.*, 309, 1937. From *Exp. Sta. Rec.*, 77, **5**, 1937, p. 619.) An account of experiments carried out in South Carolina in which a strain of Cleveland cotton was grown continuously on Cecil sandy clay loam in small concrete-walled plats, receiving basal applications of superphosphate and potassium chloride and 15 different carriers as single sources of nitrogen and some of these in combinations. In 1928-30 the rate equalled 1,000 lb. of 5-10-4 fertilizer and in 1931-35, 600 lb. of 3·3-8-4. The soil, originally pH 5·58, was limed in two series at respective rates of 1,720 and 3,440 lb. of calcium hydroxide per acre. Rye was the winter cover on all plats except a few growing Austrian winter peas.

Only slight differences in soil reaction were observed following the use of the various nitrogen fertilizers. The average increase from lime was only 150 lb. or 7·5 per cent. of seed cotton per acre, the greatest response from lime being secured with Milorganite, equivalent to 24·6 per cent. On the unlimed plats the highest yield was secured from calcium nitrate and on the limed plats from cottonseed meal. No marked differences in the yields evidently are to be expected from the use of various nitrogen sources on limed soil with a desirable reaction.

Applied at rates of 5 tons per acre each as nitrogen sources 1928-35, green vetch produced an average of 2,610 lb. of seed cotton, cow manure 2,325, and no nitrogen 1,449 lb. Yields were increased slightly by use of 2 tons per acre of dry rye straw in combination with sodium nitrate.

308. RELATIVE VALUE OF DIFFERENT BRANDS OF SODIUM NITRATE IN COTTON PRODUCTION. By H. P. Cooper *et al.* (*S. Car. Sta. Circ.*, 56, 1937. From *Exp. Sta. Rec.*, 77, **3**, 1937, p. 329.) Comparative tests, 1931-35, did not reveal significant differences in yields of cotton receiving equivalent amounts of ammonia from three brands of sodium nitrate.

309. COTTON FERTILIZERS FOR GEORGIA SOILS. By R. P. Bledsoe *et al.* (*Ga Sta. Bull.*, 196, 1937. From *Exp. Sta. Rec.*, 77, **3**, 1937, p. 328.) The largest

returns per acre were obtained when the fertilizer supplied 32 lb. each of nitrogen, phosphoric acid, and potash per acre, equivalent to the application of 533 lb. of a 6-6-6 fertilizer, 76 per cent. of the total increase being calculated as due to the nitrogen, 8 per cent. to the phosphoric acid, and 16 per cent. to the potash.

310. FERTILIZERS FOR COTTON IN LOUISIANA. By H. C. Lovett and F. L. Davis. (*La Sta. Bull.*, 284, 285, 286, 1937. From *Exp. Sta. Rec.*, 77, **4**, 1937, p. 476-7.) Co-operative fertilizer tests with cotton on the different soils of the State are discussed, and the net profits from the various treatments are shown.

311. INVESTIGATIONS ON THE MECHANICAL APPLICATION OF FERTILIZERS FOR COTTON IN NORTH CAROLINA. By E. R. Collins. (*N. Car. Sta. Agr. Inform. Circ.*, 104, 1937. From *Exp. Sta. Rec.*, 77, **3**, 1937, p. 327.) The maximum benefit from normal and higher rates of fertilizer applications was obtained by side placement from 2 to 3 inches to the side, and from 2 to 3 inches below the level of the seed. Placement to one side of the seed gave practically as good results as application to both sides.

312. SELENIUM BEARING VEGETATION DURING LATE CRETACEOUS TIME. By O. A. Beath and C. S. Gilbert. (*Sci.*, 84, No. 2187, 1936. From *Exp. Sta. Rec.*, 77, **5**, 1937, p. 600.) Evidence presented by the University of Wyoming is believed to confirm the theory that many of the existing toxic areas in the Rocky Mountain regions have originated by vegetative enrichment of selenium through cycles of growth and decay of highly seleniferous native plants, such as species of *Astragalus*.

313. A CHEAP SILO. (*E. Afr. Agr. Jour.*, iii., **3**, 1937, p. 167.) A description of silos made with Sisalkraft, a material used for lining small tower silos, which has proved useful in the United States and also in Kenya.

CULTIVATION, IRRIGATION, GINNING, ETC.

314. INCREASING THE SPEED OF READING GERMINATION TESTS. By W. Crosier and S. Patrick. (*Farm Res.*, 3, **4**, New York State Sta., 1937. From *Exp. Sta. Rec.*, 77, **6**, 1937, p. 781.) An organic mercury compound diluted with certain dusts, used to treat seeds to be tested for germination, surpassed other materials tried in respect to normal seedling development, germination percentage, freedom from micro-organisms, and cost of application.

315. COMPETITION BETWEEN COTTON VARIETIES: A REPLY. By B. G. Christidis. (*J. Amer. Soc. Agron.*, **29**, 1937, p. 703. From *Pl. Brc. Absts.*, viii., **2**, 1938, p. 159.) In an article by Quinby, Killough and Stansel it is stated that the data given by Christidis in a previous paper could be interpreted in harmony with their conclusion that competition is not an important factor in cotton variety tests. In the present note Christidis points out that this conclusion is based on an arithmetical error.

[*Cf.* Abstrs. **575**, Vol. XII. and **650**, Vol. XIV., of this Review.]

316. CULTIVATION MACHINERY. We have received from Messrs. Ransomes, Sims, and Jefferies, Ltd., a copy of their Catalogue No. 12940E, containing excellent illustrations and descriptions of the cultivators, harrows, share and disc ploughs, and other implements for animal draught that are manufactured by them. Special attention is drawn to the new 2- and 3-furrow ploughs, Voorsitter S.31 and Baanbreker S.32, both of which contain features not possessed by other ploughs. Photographs are included showing the implements in use under widely varying conditions in different parts of the world, and these should prove of interest to oversea agriculturists.

317. Changes in Farm Power and Equipment: The Mechanical Cotton Picker. By R. L. Horne and E. G. McKibben. (*Studies of Changing Tech. and Employment in Agr. Rpt., No. A-2.* Philadelphia, 1937.) A discussion of the stripper-type cotton harvester and the Rust Bros. mechanical cotton picker, and of the probable effects of a successful picker on labour.

The principal conclusion drawn from this study is that while the mechanical cotton picker is not likely to be widely introduced in the Cotton Belt within a year or two, the machines being developed have reached a sufficiently high standard of perfection to foreshadow the eventual application of mechanical cotton harvesters to about half of the present cotton acreage. The widespread introduction of a successful mechanical cotton picker is likely to involve a geographical shift of cotton production to areas most suitable to mechanization, an increase in the size of cotton farms, and an eventual displacement of upward of half a million hand pickers, with consequent increased pressure on the industrial labour market of the South.

318. A Multiple Picking Experiment: The Improvement of Grade. By W. L. Balls and H. A. Hancock. (*Tech. and Sci. Serv. Bull.*, No. 187. Min. of Agr., Egypt, 1937.) A discussion of experiments carried out on the multiple picking of Giza 26 cotton with a view to improving the grade. Whether judged by grade or yarn strength, the highest valued crop is obtained by picking at three-weekly intervals. The conventional method of picking in Egypt is the four-weeks system, which in this experiment gives a 4 per cent. lower cash return than the three-weeks system. Experiments to improve the grade by " Mabruma sorting," that is by removal of bolls not fully opened, indicated that the removal of 8 per cent. of the mabruma improves the sorted cotton by half a grade, but on account of the low price of mabruma the cultivator loses $17 per 100 kantars. Other experiments carried out on mabruma sorting with Sakel and Giza 12 cottons showed a similar loss. Grade, being largely a measure of the proportion of damaged bolls, was found not to deteriorate when cotton is left on the plant. A genuine and typical FGF cotton cannot be obtained simply by adding leaf and similar impurity to a Fully Good cotton, but it can be produced by adding mabruma to FG cotton. Conversely, late maturing low grade can be made equal to early high grades by removing mabruma. Low grade differs from high grade cotton not merely in the percentage of impurity present, but in the increased proportion of short, broken, or immature hairs from damaged bolls in the lower grades. This cotton makes up a large part of card waste. The association of irregular staple with low grade has given rise to the belief that regularity of staple is an essential character to work for in plant breeding research. Actually, so long as boll damage by pests does not enter into the story, the differences in irregularity of staplo normally found between varieties are of little importance, and many cottons produce a good strong yarn in spite of irregularity of staple.

COTTONSEED AND OIL.

319. Vegetable Oils and Oilseeds. (Printed and pubd. for the Imperial Econ. Committee by H.M. Stat. Off., 1937. Price 2s. 6d. net, 2s. 9d. post free.) A summary of figures of production and trade relating to cottonseed, linseed, rapeseed, sesame seed, soya beans, groundnuts, copra, palm kernels, palm oil, and olive oil, compiled in the Intelligence Branch of the Imperial Economic Committee. In connection with cottonseed, information is given of acreage under cotton, production of cottonseed, exports, imports, and trade in and prices of cottonseed oil.

320. COTTON SEED HUSKS AND LINTERS: UTILIZATION. By Chang-Kenk Kao and Chi-Hsing Yu. (*J. Chem. Eng.*, China, **3**, 1936, p. 331. From *Summ. of Curr. Lit.*, xvii., **20**, 1937, p. 611.) The mixture of seed husk and linters from cottonseed crushing gave nearly 25 per cent. of glucose. The husk alone gave 12-34 per cent. of xylose, 5·8-11·2 per cent. of furfuraldehyde, and 19·5-24 per cent. of glucose. Linters lost 18-28 per cent. in weight on treatment with caustic soda. Bleached linters gave 87·3 per cent. of *a*-cellulose and had copper number 1·33.

321. COTTON SEEDS: OXIDASE CONTENTS AND GERMINATION CAPACITY. By S. Nakatomi. (*Proc. Crop. Sc. Soc. Japan*, **8**, 1936. From *Summ. of Curr. Lit.*, xviii., **2**, 1938, p. 46.) Comparative studies on the germination of seeds of cotton species, *Gossypium herbaceum*, *G. hirsutum* and *G. barbadense*, have formerly led the author to the conclusion that the difference of velocity of this process in these three species depends among others on that of the peroxydase content therein—*i.e.*, the greater the latter the more rapid the process. Recently, however, the author has observed that in *G. barbadense*, notwithstanding feeble peroxydase action, germination is considerably more rapid than in *G. hirsutum*, though not more rapid than in *G. herbaceum*. In *G. barbadense* the action of peroxydase is as feeble as in *G. hirsutum*, but that of oxydase is stronger than in either of the two other species, whence the rapidity of germination of its seeds. The same may be said of the water absorbing capacity of seeds of the respective species. The cross *hirsutum*×*barbadense* was performed. Seeds of F_1 generation lie between the two parents in regard to oxydase action, and in F_2 the monohybrid segregation of germination velocity was observed, proving that this character is of hereditary nature.

322. SOME DIGESTIBILITY TRIALS ON INDIAN FEEDING STUFFS: COTTON SEED CAKE AS A CATTLE FEED. By P. E. Lander and L. C. Dharmani. (*Ind. J. Vet. Sci. and Anim. Husb.*, **7**, 225. From *Agr. and Livestock in India*, vii., **6**, 1937, p. 771.) Trials carried out with cottonseed cake produced from 4F American cottonseed without preliminary delinting and decorticating have shown this to be a highly nutritious and economic food for cattle. The albuminoid ratio was 1 : 3·1, and the cake possessed 18 lb. of digestible protein per cent.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

323. CAMOUFLAGED INSECTICIDES. (*Science*, **86**, No. 2235, October, 1937.) M. R. Coe of the U.S. Dept. of Agriculture has taken a patent for insecticides, the particles of which are covered with a thin film of dye, making them practically invisible, and mixed with which are substances protecting the dust from the harmful solar rays, and so prolonging the insecticidal life.

324. TOXICITY OF A NUMBER OF INSECTICIDES TO THREE COTTON INSECTS. By G. L. Smith and A. L. Scales. (*J. Econ. Ent.*, xxx., **6**, 1937, p. 864.) The results of tests carried out at Tallulah, Louisiana, indicated that against the boll weevil calcium arsenate, cubé, Paris green, and mixtures of calcium arsenate and Paris green were the most effective insecticides. Against the cotton leafworm (*Alabama argillacea*) calcium arsenate, pyrethrum (0·76 per cent. total pyrethrins), Paris green, or mixtures of calcium arsenate and Paris green caused about the same mortality. Against the nymphs and adults of the tarnished plant bug (*Lygus pratensis*) pyrethrum and Paris green caused the highest mortalities.

325. THE PHYSIOLOGY OF HOST-PARASITE RELATIONS. By W. Brown. (*Bot. Rev.*, ii., **4**, 1936. From *Exp. Sta. Rec.*, **77**, **3**, 1937, p. 342.) Following a

general introductory section, the bulk of the review discusses the stages of parasitism and the facultative and obligate parasites. Brief notice is given to acquired immunity in plants, and a bibliography of 149 titles is included.

326. CONTROL EXPERIMENTS WITH INSECT PESTS OF COTTON. By K. Fukuda. (In Japanese.) (*Formosan Agr. Rev.*, 33, **6**, 1937. From *Rev. App. Ent.*, xxv., Ser. A, **12**, 1937, p. 744.) Sprays of pyrethrum and soap are effective against the nymphs of *Empoasca biguttula*, but only slightly so against the eggs and adults. Spraying with lead arsenate controls *Sylepta derogata* and *Cosmophila* (*Anomis*) *flava fimbriago*, but derris is less effective. Sprayed plants appear to open their bolls later than others, and yield a much larger crop.

327. IL COTONE; NEMICIE E MALATTIE. By G. Trinchieri. (*Gior. di Agr. della Domenica*, 26/9/37, p. 327.) A brief account of the pests and diseases of cotton that occur in or near Abyssinia, including pink bollworm, stainers, red bollworm, and blackarm disease, and of the work carried out on them in other parts of Africa.

328. THE DISTRIBUTION OF IMPORTANT COTTON INSECTS RECORDED IN CHINESE LITERATURE. By F. Li and S. Chou. (In Chinese, with summary in English.) (*Ent. and Phytopath.*, v., **15-16**, pp. 282-302, Hangchow, 1937. From *Rev. App. Ent.*, xxv., Ser. A, **10**, 1937, p. 635.) A list of the chief pests of cotton in China is compiled from the literature, with references to over 200 periodicals. Those dealt with include *Platyedra gossypiella*, *Aphis gossypii*, *Agrotis* spp., *Earias cupreoviridis*, *Sylepta derogata*, *Tetranychus telarius*, *Empoasca biguttula*, and *Heliothis obsoleta*. Maps show the distribution of each, and notes are given on the severity of injury and the year in which each record was made.

329. ON SOME CONTROL MEASURES OF THE COTTON INSECT PESTS OF CHINA. By F. Li. (In Chinese.) (*Ent. and Phytopath.*, 5, **1**, Hangchow, 1937. From *Rev. App. Ent.*, xxv., Ser. A, **12**, 1937, p. 791.) The author estimates that the total number of insect pests of cotton in China is 161, and that they cause an annual loss of about £12,500,000. About 50 per cent. of this loss is due to *Platyedra gossypiella* (pink bollworm), and about 20 per cent. to *Earias cupreoviridis*. An account is given of control measures suitable for application in China.

330. SOUTH CAROLINA. *Cotton Pests*, 1936. (*Rpt. S. Car. Exp. Sta.* 49, 1935-36. From *Rev. App. Ent.*, xxv., Ser. A, **10**, 1937, p. 629.) It is reported by J. G. Watts that *Sericothrips variabilis*, Beach, constituted about 75 per cent. of all thrips on young cotton, and was more abundant than usual on other plants. By means of marking experiments it was shown that stalks severely injured by thrips produced fewer blooms and bolls than uninjured stalks, and were ten days later in commencing to bloom, so that more of the crop was heavily attacked by the boll weevil. Out of nine combinations of insecticides tested for the control of thrips on cotton, a dust of 10 per cent. Paris green and 90 per cent. dusting sulphur gave the greatest reduction in population and the lowest percentage of injured stalks; it did not injure the plants. The resistance of different varieties of cotton to this insect as measured by the percentage of injured stalks is shown in a table, and varied by 13·86 per cent. The cotton flea-hopper, *Psallus seriatus*, Reut., was abundant during the season, and experiments showed that the addition of Paris green to the standard dusting sulphur (which is applied at the rate of 15 lb. per acre) increased the killing power considerably. A dust of calcium arsenate and Paris green gave better results; it was more expensive, but was also useful in controlling the boll weevil.

331. Tests of Insecticides for Cotton Boll Weevil and Bollworm Control: Using the Latin Square Plat Arrangement and Analysis of Variance. By J. C. Gaines. (*J. Econ. Ent.*, xxx., **3**, 1937, p. 785.) In these tests, calcium arsenate alone, calcium arsenate—sulphur 50 : 50, calcium arsenate plus 5 per cent. Paris green, and calcium arsenate plus 25 per cent. lime were equally effective in controlling the boll weevil, and, with the exception of the last, the bollworm also. Sulphur, Paris green, or lime did not prevent the increase of aphids that occurred on all the blocks.

332. Possibilities of Reducing Overwintering Pink Bollworm Population in the Soil as Shown by Stripping Tests. By A. J. Chapman and H. S. Cavitt. (*J. Econ. Ent.*, xxx., **6**, 1937, p. 837.) The tests were carried out on four plots in a field heavily infested with pink bollworm. Stripping the cotton plants of squares, blooms, and bolls on October 1 reduced the soil population of pink bollworm larvæ approximately 75 per cent.; on October 15 by 51 per cent.; and on November 1 by 18 per cent. The results indicate the necessity for early maturity of the crop combined with early picking and clean-up of the fields in order to reduce the overwintering pink bollworm population.

333. Nocturnal Habits of *Platyedra gossypiella* Saunders. By F. A. Squire. (*Nature*, **140**, No. 3432, 1937, p. 69. From *Rev. App. Ent.*, xxv., Ser. A, **10**, 1937, p. 631.) Records are given from the literature showing that in Egypt *Platyedra gossypiella* Saund. is attracted to light, whereas in Hawaii it is believed to avoid it. Observations in St. Vincent, British West Indies, showed that there the moths are attracted from 8 p.m. to 4 a.m., but are concealed by 5 a.m. although it is still dark. Attraction to light was strongest during the mating period, and long- and short-cycle moths were equally phototropic.

Pairing took place 1-5 days after emergence, and generally occurred in the last two hours of the active nightly period. The pre-oviposition period lasted about three days. Oviposition and feeding took place at any hour of the night.

334. Parasites of Pink Bollworm in Northern Mexico. By C. S. Rude. (*J. Econ. Ent.*, xxx., **6**, 1937, p. 838.) The chief parasites discussed are: *Anachætopsis*, *Microbracon platynotæ*, *M. mellitor*, *Perisierola cellularis* var. *punctaticeps*, and *Catolaccus hunteri*.

335. Imported Parasites of Pink Bollworm at Presidio, Texas, 1932-36. By L. W. Noble and W. R. Hunt. (*J. Econ. Ent.*, xxx., **6**, 1937, p. 842.) During the past five years the following six species of parasites have been introduced, but, with the exception of the last one, they have given no evidence of becoming established: *Exeristes roborator*, *Microbracon brevicornis*, *M. kirkpatricki*, *M. mellitor*, *Chelonus blackburni*, *Elasmus platyedræ*.

336. The Effectiveness of Cultivation as a Control for the Corn Earworm. By G. W. Barber and F. F. Dicke. (*Tech. Bull. U.S. Dpt. Agr. No.* 561, 1937. From *Rev. App. Ent.*, xxv., Ser. A, **10**, 1937, p. 619.) Experiments were carried out with simulated and actual ploughing of a Piedmont red clay, a sandy loam and an artificial soil with a high humus content at Charlottesville, Virginia, and a fine sand soil at Savannah, Georgia, during the period 1928-33, to determine the effect on the corn earworm, *Heliothis obsoleta*, emerging from hibernation. The larvæ were kept in two types of cages (described), the second and larger type being used as a control.

In experiments on the soil with a high humus content nearly all the pupæ were killed by the fungus *Sorosporella uvella*, and over the five-year period no moths emerged. For five years on red clay and sandy loam and for two years on the fine sand soil the percentages of larvæ that gave rise to moths in the

small cages were 1·13, 0·3 and 7·8 respectively when the soil was dug over in autumn, 9·1, 10·1, and 31·4 when it was left untreated, and 1·6, 0·7 and 13·5 when it was dug over in spring. Disking the sandy loam soil in the autumn reduced the percentages of emerging moths from 9·8 to 1·75 in the large cages. It is concluded that contact with the earth on all sides during hibernation, preventing air-circulation, is unfavourable to pupal survival, and that the natural packing of the soil during hibernation is unfavourable to emergence. Autumn and spring ploughing and autumn disking are, in this order, important factors in controlling the corn earworm, although none gives complete control.

337. Variations in Population and in Size of Adults of *Trichogramma minutum* Emerging from Eggs of *Heliothis obsoleta* (American Bollworm). By G. W. Barber. (*Ann. Ent. Soc. Amer.*, 30, 2, 1937. From *Rev. App. Ent.*, xxv., Ser. A, 11, 1937, p. 720.) The population of parasites per host egg ranged from 1 to 5. Approximately twice as many females as males were recovered. The largest male had about 25 times the bulk of the smallest male, and the largest female about 40 times the bulk of the smallest female. It would appear that a determining cause of variation in size of adults of *T. minutum* reared in a single host egg is the competition for food among the larvæ.

338. Cotton Flea Hopper: An Ecological Problem. By F. L. Thomas and W. L. Owen. (*J. Econ. Ent.*, xxx., 6, 1937, p. 848.) Flea hopper injury to cotton in Texas is more severe on the heavier than on the lighter types of soil, the water-retaining capacity of the former soils being a factor in the length of period cotton remains succulent, and therefore attractive to the pest. The flea hopper prefers other plants or weeds to cotton, such as primrose, horsemints, and croton or goatweeds, and if these are in abundance injury to cotton will not be serious.

339. Cotton Flea Hopper Control in 1936. By K. P. Ewing and R. L. McGarr. (*J. Econ. Ent.*, xxx., 6, 1937, p. 850.) Four small-plot experiments and four large-scale dusting experiments were conducted, comparing sulphur, a mixture of 10 per cent. Paris green and 90 per cent. sulphur, and a mixture of 20 per cent. calcium arsenate and 80 per cent. sulphur, for control of the cotton flea hopper. Infestation records showed practically no difference between the control effected by the two mixtures, and both mixtures gave better control than sulphur alone. Bloom counts in the small-plot experiments showed that the cotton dusted with each mixture fruited about the same. In plots dusted with sulphur there was an average of 86 per cent. as many blooms as in the plots dusted with mixtures, while in the untreated plots there were less than half as many as in the treated plots. The average gain in pounds of seed cotton per acre from the eight experiments was as follows: Paris green and sulphur mixture, 128·9 lb.; calcium arsenate and sulphur mixture, 111·9 lb.; and sulphur, 111·1 lb.

340. Intensive Demonstrations in Cotton Flea Hopper Control. By R. R. Reppert. (*J. Econ. Ent.*, xxx., 3, 1937, p. 712.) An account of experiments carried out in the black lands of Texas on the control of cotton flea hopper by dusting with finely ground sulphur. The costs, including both sulphur and labour, varied from $2 to $4 per acre for the season (1936), and the increased yield of the treated over the untreated areas varied from 102 to 361 lb. of seed cotton per acre, the net monetary profit being from $2·08 to $10·44 per acre.

341. The Bird Enemies of the Cotton Leaf Roller (*Sylepta derogata*) at Khanewal, Multan, Punjab. By M. A. Husain and H. R. Bhalla. (*Ind.*

J. of Agr. Sci., vii., 4, 1937, p. 785.) Among the birds mentioned as feeding on leaf roller were the Himalayan starling, crows, larks, shrikes, ravens, quails, and partridges.

342. Leafhoppers found on Cotton. By R. K. Fletcher. (*J. Econ. Ent.*, xxx., 6, 1937, p. 863.) A list is given of 29 species of leafhopper found on cotton in Texas.

343. Cutworms in Seedling Cotton. By W. J. S. Sloan. (*Queensland Agr. J.*, October, 1937, p. 503.) The cutworm—the larva of a dark-brown moth—is a stout, soft-bodied, greyish-brown caterpillar of 1½ inches in length. The pest feeds at night, and normally attacks the stems of cotton seedlings just above ground level. Good control is effected with a poison bran bait as follows: 25 lb. bran, 1 lb. Paris green, 2 quarts molasses, and enough water (2-2½ gals.) to make a friable, crumbly mash. The bait should be applied in the late afternoon or evening.

344. Some Recent Advances in Research on Locust Problems. By J. C. Faure. (*S. Afr. J. Sci.*, **33**, 1937, p. 797. From *Rev. App. Ent.*, xxv., Ser. A, **10**, 1937, p. 632.) After a review of recent literature on the phase and the genotypic variations in Acrididæ, the outbreak centres of *Locustana pardalina*, Wlk., and *Nomadacris septemfasciata*, Serv., in Africa are discussed and illustrated by maps. In 1935 poison bait was adopted as the standard control measure against the hoppers of *Locustana*. It is prepared by mixing 92 lb. coarse whole maize meal with 7 lb. molasses and 1 lb. sodium arsenite, and coloured with vegetable black to give it a warning coloration at the rate of 3 parts per thousand. It is issued containing about 10 per cent. moisture, moistened with 8-10 gals. water to 100 lb. before use, and broadcast at the rate of 60 lb. (dry weight) to an acre. This bait is very attractive to *Locustana*, but *Nomadacris* hoppers will only feed on it in the mornings and evenings, when they are less active; its efficiency is not diminished by rain showers and dew. The taking of samples to estimate the mortality was facilitated by surrounding portions of resting hopper bands with iron barriers, 18 inches and 36 inches high, for *Locustana* and *Nomadacris* respectively.

345. The Effect of Temperature on Locust Activity. By M. Hussein. (*Tech. and Sci. Serv. Bull. No.* 184, Min. of Agr., Egypt, 1937.) In a preface Dr. Uvarov states that it has been fully proved that the behaviour of locusts is governed by the temperature of the environment, not directly, but through their body temperature, which undergoes changes parallel to those in the air temperature. "Another important point arising out of the author's work is the one relating to what should be considered 'normal activity.' His observations show that rapid crawling, frequent jumps (and wing movement in the case of adults) begin at a stage when the locust cannot be regarded as behaving normally, and exhibits obvious signs of excitement. Therefore, mass movements of hoppers and flights of adults, which are so characteristic of locusts, are not normal movements, but are caused by excessive temperatures. These movements are definitely due to external factors, and they continue only as long as the conditions remain unfavourable. This conclusion gives a clue to the understanding of the causes of locust migrations on a sound scientific basis."

346. A Study of Spontaneous Locomotor Activity in *Locusta migratoria migratorioides* by the Actograph Method. By E. B. Edney. (*Bull. Ent. Res.*, xxviii., **2**, 1937, p. 243. From *Rev. App. Ent.*, xxv., Ser. A, **10**, 1937, p. 646.) To provide quantitative data on spontaneous activity shown by locusts the activity of different instars of *Locusta migratoria* ph. *solitaria* was

recorded by means of an actograph apparatus, adapted for recording in 24-hour periods. This is described, and the results are expressed in terms of distances travelled.

347. Action de *Bacillus prodigiosus* et *Bacillus pyocyaneus* sur le Criquet Pélerin (*Schistocerca gregaria* Forsk.). By P. Lepesme. (*C. R. Soc. Biol.*, 125, **19**, 1937. From *Rev. App. Ent.*, xxv., Ser. A, **11**, 1937, p. 657.) In the course of an epidemic that occurred in a batch of *Schistocerca gregaria* that was being reared in the laboratory, it was observed that *Bacillus prodigiosus* and *B. pyocyaneus* were present in the body fluids of affected locusts. Their effect on the locusts was therefore investigated by inoculating a pure culture of one or other of them into the body cavity. This caused death in 1-2 days; the bodies assumed a characteristic coloration varying from violet-pink to bright red, and putrefied rapidly. Ingestion of the same culture produced death only occasionally. Experiments showed that the virulence of the *Bacillus* was not increased by successive passages through the locusts.

348. Sur un Procédé Nouveau de Protection des Cultures contre les Acridiens. By M. Volkonsky. (*C. R. Soc. Biol.*, 125, **18**, 1937. From *Rev. App. Ent.*, xxv., Ser. A, **11**, 1937, p. 670.) Observations in Algeria have shown that *Melia azedarach* is not touched by locusts, and any cultivated plants can be made repellent to them by being sprayed with extracts prepared from its leaves. The active principle can be extracted with hot water, alcohol, chloroform, or benzene, but not with petroleum ether. The extract from 2 lb. dry leaves in 10 gals. water affords effective protection against *Schistocerca gregaria*, but 2½ times this strength is required against *Dociostaurus maroccanus*, *Calliptamus italicus*, and *Anacridium ægyptium*. The extracts are not poisonous to mammals, and are unaffected by exposure to sun or rain. Concentrated extracts which can later be diluted with water for spraying can be prepared by evaporating alcohol extracts to one-fifth the weight of dry leaves used and adding a small quantity of glycerine.

349. Sur la Destruction des Sauterelles au Moyen du Fluosilicate de Sodium. By P. B. Richards. (*Bull. Off. Int. Hyg. Pubn.* 29, 1937. From *Rev. App. Ent.*, xxv., Ser. A, **11**, 1937, p. 681.) In 1930 sodium fluosilicate was tested in baits for locusts, *Schistocerca gregaria*, in the Dehra Dun district, India. When baits of 40 lb. bran, ¾-1 lb. sodium fluosilicate and 1 lb. grease or salt, moistened with about 9 gals. water, were broadcast at the rate of 176 lb. per acre, all the locusts, including older hoppers and adults, were dead in 5 days. Since a great deal of bait remained on the ground it was suggested that the rate be 88 lb. to 2½-3 acres.

In tests of the effect of the poison on domestic animals, bulls given doses of from 5-25 grains sodium fluosilicate showed no pathological symptoms, and one recovered even after a dose of ½ oz. When 6 bulls, 2 buffaloes, 3 sheep and 3 goats were allowed to graze for 8 days on an acre of land over which was spread a mixture of 50 lb. bran, 2 lb. molasses and 1 lb. sodium fluosilicate they did not appear to have been affected in any way.

350. A Biometrical Study of the Adult Components of Philippine Locust Swarms. By L. B. Uichanco and R. B. Gines. (*Philip. Agr.*, xxvi., **3**, 1937. From *Rev. App. Ent.*, xxv., Ser. A, **11**, 1937, p. 711.) A detailed biometrical study of over 19,000 specimens from different swarms.

351. Studies on the Red Bollworm of Cotton, *Diparopsis castanea*, Hampson. Pt. I., The Distribution and Ecology of Two Natural Food Plants, *Cienfuegosia Hildebrandtii*, Gürke, and *Gossypium herbaceum* var. *Africana*,

WATT. By J. Marshall, F. S. Parsons, and H. Hutchinson. (*Bull. Ent. Res.*, xxviii., **4**, 1937.) In a survey carried out in Swaziland, the wild cotton *Gossypium herbaceum* and *Cienfuegosia Hildebrandtii* were found to be important food plants of the red bollworm. The characters and distribution of these and other food plants in Swaziland and neighbouring areas between the Transvaal and Portuguese East Africa are discussed in detail. Certain portions of the Lower Bushveld are pointed out as the natural breeding-grounds of red bollworm. The most important result of the survey was the discovery that natural food plants are absent in the mid-country cotton areas, and in portions of the Low Country the only problem would appear to be the eradication of the wild cotton. The red bollworm is not a pest of the importance of the American bollworm, but the damage caused by it deters cotton-growing in years of low prices.

352. UN GRAND ENNEMI DU COTONNIER, *le Dysdercus*. By A. Brixhe. (*Bull. Trimes. du Com. Cotonn. Congolais, No.* 5, 1937, p. 23.) A brief description of the pest, its host plants, the injury caused to cotton, and measures of control.

353. THRIPS DAMAGE TO COTTON. By E. W. Dunnam and J. C. Clark. (*J. Econ. Ent.*, xxx., **6**, 1937, p. 855.) Severe injury to cotton in experimental plots at Stoneville, Mississippi, was caused in the spring of 1936 by the following species of thrips: *Frankliniella tritici, F. fusca, F. runneri,* and *Sericothrips variabilis*. In a study of thrips injury to forty varieties of cotton it was found that early chopping and allowing an average of 2·79 stalks to the hill decreased the percentage of terminal bud damage. No difference in varietal infestation was observed under the conditions of the experiment. The average boll crop for all varieties was reduced 7·72 per cent. and was set from ten days to two weeks later on the damaged plants than on the normal plants. There was an average loss of 13·38 per cent. of seed cotton, and also a decrease in the size of bolls produced by damaged plants.

354. REDUCTION OF COTTON YIELD BY THRIPS. By J. G. Watts. (*J. Econ. Ent.*, xxx., **6**, 1937, p. 860.) An account of an experiment carried out at Florence, South Carolina, to determine whether the injury by thrips to young cotton seedlings resulted in a reduction of cotton yields. In the field where the experiment was carried out it was found that 56 per cent. of the plants would have produced approximately 40 per cent. more cotton in the absence of thrips injury.

355. SPECIES OF THRIPS FOUND ON COTTON IN SOUTH CAROLINA. By J. G. Watts. (*J. Econ. Ent.*, xxx., **6**, 1937, p. 857.) Thirteen species of thrips are mentioned as being found on cotton in South Carolina.

356. THE NEED OF PERMANENT REFERENCE COLLECTIONS OF INSECT VECTORS OF PLANT DISEASES. By F. F. Smith. (*Phytopathology*, 27, **2**, 1937. From *Exp. Sta. Rec.*, 77, **6**, 1937, p. 793.) In some cases viruses are most readily identified by their vectors. Closely related insect species are also known to transmit entirely different viruses, and reference is made to several cases regarding confusion in the identity of a given vector and its effects on the results of studies of the diseases concerned. Because of the lack of agreement relative to the specificity of certain known insects, and because new species are not always readily differentiated by descriptive literature alone, it is suggested that representatives of bona fide insect vectors of plant viruses be permanently preserved in designated institutions.

357. ANNOTATED HOST LIST OF UGANDA PARASITIC FUNGI AND PLANT DISEASES. IV. By C. G. Hansford. (*E. Afr. Agr. Jour.*, iii., **3**, 1937, p. 235.) A continuation of previous lists.

[*Cf.* Abstr. **692**, Vol. XIV., and Abstr. **133**, Vol. XV. of this Review.]

358. The Effect of Three- and Four-Year Rotations on Cotton Root Rot in the Central Texas Blacklands. By C. H. Rogers. (*J. Amer. Soc. Agron.*, xxix., **8**, 1937, p. 668. From *Rev. App. Mycol.*, xvii., **1**, 1938, p. 34.) Three-year rotation combinations of maize, oats, sorghum, or fallow with cotton were ineffectual against root rot of the last-named host (*Phymatotrichum omnivorum*). Four-year rotations of cotton with maize, sorghum, oats, or wheat, however, resulted in a consistent reduction of infection, over 100 per cent. more of which occurred in the continuous than in the alternating stands. Small increases in lint yield were also obtained from cotton in three- and four-year rotations. The number and viability of the sclerotia, the primary means of propagation of *P. omnivorum*, were not reduced in the three-year rotations as compared with continuous cotton, but declined markedly in the four-year alternation. Control of root rot should be based on the exclusion of susceptible crops from the rotation for at least three years before replanting the land with cotton, and on measures—*e.g.*, green manuring—calculated to enhance soil fertility.

359. Influence of Rust on Quality and Yield of Cotton, and the Relation of Potash Applications to Control. By J. H. Moore and W. H. Rankin. (*N. Car. Sta. Bull.* 308, 1937. From *Exp. Sta. Rec.*, 77, **5**, 1937, p. 641.) The application of additional quantities of potash increased the yield and improved the quality of cotton grown on fields subject to rust damage. The experiments, however, indicated that the problem may involve other factors than potash, and further work is being planned to determine other causes and means of control.

360. The Comparative Rôle of Certain Nematodes and Fungi in the Etiology of Damping-off, or Soreshin, of Cotton. By C. H. Arndt and J. R. Christie. (*Phytopathology*, 27, **4**, 1937. From *Exp. Sta. Rec.*, 77, **3**, 1937, p. 348.) In this study cotton seedlings were grown in soil cultures artificially inoculated with *Fusarium vasinfectum*, *F. moniliforme*, *Glomerella gossypii*, *Aphelenchioides parietinus*, *Aphelenchus avenæ*, *Cephalobus elongatus*, and *Acrobeles butschlii*, each alone; each of the fungi in combination with each of the nematodes; and each of the fungi with all four nematodes. The nematodes did not produce typical soreshin lesions, and did not noticeably increase the severity of such lesions when combined with the several fungi, although they increased the stunting of the plants by *F. moniliforme*. Typical damping-off was caused by *G. gossypii*. The fusaria reduced germination and produced lesions on the hypocotyl, but did not cause typical damping-off.

361. Effect of Potash Fertilizers on Cotton Wilt. By L. E. Miles. (*Miss. Sta. Tech. Bull. No.* 23, 1936. From *Exp. Sta. Rec.*, 77, **4**, 1937, p. 499.) Fairly high potash applications combined with nitrogen- and phosphorus-containing salts were definitely beneficial in the control of cotton wilt. High nitrate applications and fertilizers containing nitrogen and phosphorus alone were inefficient for wilt control. Potash alone reduced wilt but did not return satisfactory yields. On severely infested soils a cotton variety resistant to wilt is essential in addition to a high-potash fertilizer.

362. Potash for Cotton Wilt in the Mississippi Delta Region. By L. E. Miles. (*Better Crops with Plant Food*, 20, **12**, 1936. From *Exp. Sta. Rec.*, 77, **5**, 1937, p. 642.) A continuation of previous work.

[*Cf.* Abstrs. **316**, **515**, Vol. XIV. of this Review.]

363. Fusarium como Causador da Murcha do Algodoeiro no Brasil. By H. P. Krug. (*Rodriguésia*, ii., 1936, p. 319. From *Rev. App. Mycol.*, xvii.,

1, 1938, p. 35.) The species of *Fusarium* causing cotton wilt in Brazil is stated to have been identified by H. W. Wollenweber as *F. vasinfectum* form 1.

[*Cf.* Abstr. **141**, Vol. XV. of this Review.]

364. Raw Cotton: Mildewing. By B. Prindle. (*Text. Res.*, **7**, 1937, p. 445. From *J. Text. Inst.*, xxix., **1**, 1938, A38.) A fresh sample of American medium-staple cotton in the form of combed sliver was kept at various humidities and examined for bacteria and moulds. The original sample bore mixed types of bacteria and species of *Alternaria, Hormodendron, Aspergillus, Penicillium, Mucor* and coloured *Fungi imperfecti*. Scarcely any change occurred at humidities below 82 per cent., but thereafter the bacteria disappeared to a large extent and the moulds multiplied enormously, especially in the range 86-95 per cent. R.H. The mould species that predominated at the high humidities were *Aspergillus* and *Penicillium*, though at 95 per cent. R.H. large numbers of *Actinomycetes* were also encountered.

GENERAL BOTANY, BREEDING, ETC.

365. Mastery over Plants. (*Trop. Agr.*, xv., **1**, 1938.) A discussion of the modern discovery that many of the phases of plant growth and development can be controlled by chemical means.

366. The Distribution of *Gossypium* and the Evolution of the Commercial Cottons. By J. B. Hutchinson. (Conf. of Sci. Res. Workers on Cotton in India, 1937.) Current opinions concerning the distribution and relationships of species of *Gossypium* are summarized. An account is given of the present state of knowledge of the phytogeography of the genus in the light of recent revisions of its classifications. Great extensions in the distribution of the five cultivated species have taken place in recent times, and it is shown that side by side with these extensions four of the five species have undergone very rapid evolution. The course of this recent evolutionary process has been parallel in all species. In *Gossypium hirsutum, G. herbaceum,* and the northern Indian and Chinese forms of *G. arboreum* early annual, sympodial types have been developed from perennial highly monopodial, bushy forms in response to the selective influences of short growing seasons and cold winters encountered in continental monsoon climates and in the recent northerly extensions of their distributions. The interaction of environmental pressure and evolutionary response must have been extremely close, invasion of short-season areas being impossible without the annual habit which could only be developed in response to it. In *G. barbadense* and in the southern Indian types of *G. arboreum* a similar development of annual sympodial types has taken place in the last few centuries in response to the demand of agriculture for the simpler crop management and better pest control which is possible with annual types. It is pointed out that the changes which have taken place in the cultivated species of cotton afford an excellent demonstration of the progress of evolution within historic times. The work of Skovsted on the analysis of the chromosome complement of New World cottons is referred to, and other recent theories on the subject are mentioned. Skovsted's cytological evidence, together with Harland's genetic evidence, is considered to give strong support to the theory that the 26 chromosome cottons arose by allotetraploidy from a hybrid between two 13 chromosome types, one related to the wild 13 chromosome cottons of the New World and the other related to the cultivated 13 chromosome cottons of Asia, the line of meeting of the two being across the Pacific and not across the Atlantic.

367. Cotton Leaf Sap: Composition. By E. Phillis and T. G. Mason. (*Nature*, **140**, 1937, p. 370. From *Summ. of Curr. Lit.*, xvii., **20**, 1937, p. 631.) Experiments on the extraction of sap from cotton leaves give evidence for two kinds of sap, true vacuolar sap extracted by direct pressure and cytoplasmic sap derived by the destruction of the cytoplasm by the use of shearing force. The concentration of the cytoplasmic sap is more than double that of the vacuolar sap. The authors consider the continuous phase of active cytoplasm to be "vitaid," the molecule of which is not decomposed by direct pressure but only by shearing forces as applied in a vice, by freezing or hand rubbing, the products formed being proteins, lipoids and water. This explains the fact that more sap, and of a different composition, can be obtained after freezing, by using anæsthetics, or by pressing in a vice, than by hydraulic pressure.

368. Cotton Flower Pigments: Constitution. By K. Neelakantam and T. R. Seshadri. (*Proc. Indian Acad. Sci.*, 5A, 1937, p. 257. From *Summ. of Curr. Lit.*, xvii., **21**, 1937, p. 666.) Herbacitrin, a pigment from *G. herbaceum* flowers, is the 7-glucoside of 3 : 5 : 7 : 8 : 4′-pentahydroxyflavone. On hydrolysis it yields herbacetin. Derivatives and reactions are described.

369. Petalody in Cotton. By J. B. Hutchinson, R. L. M. Ghose, and Ramanatha Ayyar. (*Curr. Sci.*, **6**, 1937, p. 99. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 103.) A type of petalody previously reported to be a simple recessive has been found by Hutchinson and Ghose to be incompletely recessive, the heterozygotes having a quarter to half their stamens slightly petaloid. Ramanatha Ayyar, one of the original authors, confirms this.

[*Cf.* Abstr. **456**, Vol. XII., of this Review.]

370. Reviews of Emasculation Methods in Cotton. By S. C. Chiang. (*J. Agr. Ass. China*, 163, 1937, p. 87. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 157.) C. C. Doak's new method of emasculation (which the author of the present paper terms Beasley's method) and the old one were compared regarding the economy of labour and the percentage of fertilization after artificial pollination. This and the average number of seconds spent on each flower were 40·5 per cent. and 37·7″ for the old and 39·9 per cent. and 11·5″ for Doak's method.

[*Cf.* Abstr. **447**, Vol. XII., of this Review.]

371. The Effect of Age on Net Assimilation and Relative Growth Rates in the Cotton Plant. By O. V. S. Heath. (*Ann. of Bot.*, New Ser., i., **3**, 1937, p. 565.) A study of the vegetative period before first flowering on random samples from experiments on net assimilation rates, calculated on the basis of leaf weight instead of leaf area, indicated no general rise or fall up to flowering time, but the relative rate of total dry weight increase (efficiency index), the relative leaf growth rate and the percentage of the total dry weight which consists of leaves, had a slight downward trend in time. The fall in the relative leaf growth rate implies that an increasing proportion of the products of photosynthesis is used for stem, flower buds, etc., as time proceeds, and the ratio of leaf weight to total dry weight also falls as a consequence.

372. The Chromosomes. By M. J. D. White. (Methuen and Co., Ltd., London, 1937. Price 3s. 6d. Reviewed in *Pl. Bre. Absts.*, viii., **2**, 1938, p. 198.) An outline of nuclear cytology dealing with the resting nucleus, mitosis and meiosis and their special problems, and the chromosomes and evolution. The text is clearly written and avoids the use of too many technical terms, the subject-matter is up-to-date, and the diagrammatic illustrations are for the most part well drawn and helpful. The book is provided with a glossary, a bibliography of 189 references, and an index.

373. CHROMOSOMES: DOUBLING BY CHEMICAL MEANS. By A. F. Blakeslee. (*C. R. Acad. Sci.*, **205**, 1937, p. 476. From *Summ. of Curr. Lit.*, xvii., **21**, 1937, p. 663.) The doubling of the number of chromosomes in a plant not only increases the size of the organs, thereby producing larger fruits and flowers, but also transforms sterile plants into fertile ones, diœcious varieties into hermaphrodites, and annuals into perennials; it also imparts resistance to cold. Colchicine is reported as a particularly powerful agent for securing this effect on chromosomes. Plants may be watered with a 0·2 per cent. solution or shoots treated with a mixture of colchicine and lanoline.

374. AN IMPROVED METHOD FOR THE STUDY OF CHROMOSOMES. By E. C. Jeffrey. (*Stain Tech.*, 12, **1**, 1937. From *Exp. Sta. Rec.*, 77, **5**, 1937, p. 604.) Using the chromosome fixation method described, excellent results were obtained by cutting up the material in very thin slices of almost microscopical tenuity and passing them immediately into fixing solutions containing osmic acid. The material was then assembled on cards, and after embedding in nitrocellulose, sectioned to 5μ or even thinner. Practically all methods of staining may be used, but the best results were obtained with Heidenhain's hematoxylin bleached almost to disappearance and followed by prolonged treatment with aqueous safranin. The differentiation of the chromosomes thus obtained indicates that they consist of a ground substance in which are situated two chromatids. In somatic tissues these chromatids generally appear to be spirals running in opposite directions. The crossing points of these spirals are responsible for the optical illusion which has been designated the "gene."

375. WHAT IS A HYBRID? By C. D. Darlington. (*J. Hered.*, 28, 1937, p. 115. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 115.) The genetical definition of a hybrid is given as "a zygote produced by the union of dissimilar gametes (or which by mutation has the character of such a zygote)."

376. THE EFFECT OF VARIATION ON FITNESS. By J. S. B. Haldane. (*Amer. Nat.*, **71**, 1937, p. 337. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 117.) A mathematical investigation of the effects of different types of variation on fitness, the fitness of any particular genotype being defined as half the mean number of progeny left by an individual of that genotype.

377. COTTON PLANT: GENETICS. By S. C. Harland. (*Nature*, **144**, 1937, p. 467. From *Summ. of Curr. Lit.*, xvii., **21**, 1937, p. 663.) It is now established on genetical as well as cytological grounds that the New World cultivated cottons are amphidiploid in origin and that thirteen-chromosome species from both Asia and North America have played a part in their formation.

378. INTERSPECIFIC HYBRIDIZATION IN COTTON. By K. C. Amin (*Poona Agr. Coll. Mag.*, 29, 1937, p. 50. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 102.) Another ten American-Asiatic hybrids have been raised. Using *Gossypium hirsutum* as pollen parent twenty back-cross hybrids have been obtained, while by pollinating American cotton with hybrid pollen one back-cross hybrid was produced and has given rise to twelve plants in the next generation. The F_1 hybrids are being maintained as ratoons, and it has been found possible to propagate them by cuttings. Attempts to produce callus formation with a view to inducing chromosome doubling have been without success.

379. THE ANALYSIS OF SINGLE-FACTOR SEGREGATIONS. By K. Mather. (*Ann. Eugen.*, Cambs., **8**, 1937, p. 96. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 95.) A test for deviation from the single factor ratio, allowing the combination of F_2 and back-cross data, is given, with a test for heterogeneity of the two sets of data. The method is illustrated by application to a case of a good 3 : 1 ratio and to

a case in which the ratio was disturbed by linkage with a lethal factor, this case being analyzed in some detail. The relative values of F_2 and back-cross families in testing for deviations from single factor expectations are discussed and it is shown that when the proportion of recessive gametes given by the F_1 is $\frac{1}{2}$, which is the normal case, three plants of an F_2 yield as much information as four plants of the back-cross.

380. MENDEL, MORGAN AND GENETICS. By E. W. MacBride. (*Nature*, **140**, 1937, p. 348. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 95.) The author endeavours to show that the chromosome theory of heredity is invalid, being based on incorrect assumptions.

381. GENETICS IN ITS APPLICATION TO PLANT BREEDING. By P. S. Hudson. (*Curr. Sci.*, **6**, 1937, p. 36. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 94.) The topics covered in this survey are single-plant selection, geographical distribution, distant hybridization, amphidiploidy, physiological specialization in parasitic fungi, breeding for disease resistance, induced mutation, vernalization, breeding for earliness, and finally, yield.

382. A STUDY ON NATURAL CROSSING IN COTTON. By C. P. Tu. (*J. Agr. Ass. China*, **125**, 1934. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 157.) Describes experiments carried out to determine the percentage of natural crossing in American Trice and China T. H. cottons, using the method suggested by Dr. H. H. Love.

383. A DISCUSSION ON THE METHODS OF STUDYING THE PERCENTAGE OF NATURAL CROSSING IN COTTON. By C. P. Yu and L. C. Hsieh. (*J. Agr. Ass. China*, **160**, 1937. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 158.) The authors criticize the method employed for testing the percentage of natural crossing in cotton suggested by Dr. H. H. Love, and state that another method employed by many earlier investigators is preferable.

[*Cf.* previous Abstract and Abstrs. **379** and **380**, Vol. XII., of this Review.]

384. HYBRIDIZATION WORK WITH SPECIES OF COTTON WITH DIFFERENT CHROMOSOME NUMBERS. By S. S. Kanas. (*Bjull. Veeso. Akad. S.-Kh. Nauk im. V. I. Lenina*, 12, 1936. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 156.) An account from the Transcaucasian Section of the Central Breeding Station of the work that has been done with crosses between 26- and 52-chromosome species of cotton. In the majority of the crosses the F_1 had 39 chromosomes as the somatic number, except in the cross of *Gossypium barbadense* by *G. herbaceum*, in which 2n equalled 52 as a result of the combination of the haploid complement of the first species with two haploid complements of the second species. The general sterility noted in the F_1 generations was to some extent eliminated by repeated crossing with 52-chromosome species. A similar improvement in fertility was noted when the F_1 pollen was used on the parent forms. Hybrids from the first back-cross were more fertile than the F_1 and some forms even attained 10 per cent. fertility, but others showed a much lower percentage. Morphological features also varied greatly, while at the same time there was a marked predominance of the characters of the 52-chromosome species. In some back-crosses characters absent in the parents appeared. The chromosome complements of some of these various forms and of 65-chromosome hybrids (resulting from non-reduced F_1 ♀ gametes with 39 chromosomes pollinated by 26-chromosome pollen) are mentioned, with general observations on the cytological findings in the F_2 generations and back-crosses from crosses involving two or three species. Data are also cited as showing that constant forms can be attained sooner in crosses between species of different chromosome

number than in crosses of species with the same chromosome number or even in intraspecific crosses.

385. Homologous Loci in Wild and Cultivated American Cottons. By S. C. Harland. (*Nature*, **140**, 1937, p. 467. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 102.) The triploid hybrids between *Gossypium barbadense* (n=26) and the wild American species *G. aridum*, *G. armourianum* and *G. tribolum* (n—13) were found to be weakly fertile on the male side. By making two successive back-crosses of the hybrids with *barbadense* or *hirsutum* fertility was completely restored and the following transferences of genes from the wild to the cultivated species were effected: normal (Cr) from *aridum*, *armourianum* and *tribolum* to *barbadense* crinkled (cr); (S^{B}) Petal Spot from *aridum* to *barbadense* and *hirsutum*, and (S^{AR}) Petal Spot from *armourianum* to *barbadense*. The existence in the wild species of allelomorphs of factors in the cultivated species is thus demonstrated and supports the theory that the cultivated cottons of the New World are amphidiploid in origin and that 13-chromosome species from both Asia and America have played a part in their formation. The normal allelomorphs of crinkled carried by *aridum* and *tribolum* appear to be of a lower dominance potency than that of *barbadense*. The *aridum* and *armourianum* genes for petal spot also appear to be different from those of either *barbadense* or *hirsutum*.

386. The Genetics of Lintlessness in Asiatic Cottons. By J. B. Hutchinson and P. D. Gadkari. (*J. of Genetics*, xxxv., **2**, 1937, p. 161.) Seven types of lintless occurring in Asiatic cottons are described. It is shown that at least four independent genes are involved. Two of these are complementary genes for glabrous lintless and two complementary genes for hairy lintless. The relationship of the $\mathbf{li_c}$ gene carried by Punjab H.L. to the rest has not been fully worked out, and it remains to be seen whether it is the same as one of the hairy lintless complementary pair. Data are presented to show that the hairy lintless homozygote $\mathbf{li_c}$-$\mathbf{li_c}$ shown by Afzal and Hutchinson (1933) to be a lethal is now fully viable both in the original strain and in a hybrid with Narrow kokati. The probable cause of the change and its bearings on Fisher's theory of the origin of dominance are discussed. The linkage relations of the lintless genes were studied, but no satisfactory evidence of linkage was found. There was, however, a strong association between $\mathbf{li_c}$ and leaf shape in segregating families in which considerable mutation from narrow to broad leaf had occurred. This association could not be ascribed to linkage.

387. A Note on Two New Genes Affecting Anthocyanin Pigmentation in Asiatic Cottons. By J. B. Hutchinson and R. L. M. Ghose. (*Ind. J. Agr. Sci.*, vii., **6**, 1937, p. 873.) A new member, red spotless, $R_2{}^{\circ}$, of the anthocyanin multiple allelomorph series is described, and its position in the series established. Red spotless differs from red leaf, $R_2{}^{L}$, in the absence of petal spot. It is pointed out that the discovery of this gene necessitates reconsideration of Hutchinson's (1934) speculation on the organization of the anthocyanin genes, and leads to the expectation that genes may be discovered giving further combinations of anthocyanin distribution. The existence is demonstrated of a petal spot reducer, S^r, in a strain of *G. arboreum* var. *neglectum* from Nagpur. A second factor probably operates to intensify the effect of S^r, but it has not yet been possible to analyze its mode of action completely.

388. Breeding Work with Egyptian Cotton. By A. I. Avtonomov. (*Bjulleten' Vsesojuznoi Akademii S.-Kh. Nauk im. V. I. Lenina*, No. 12, 1936. From *Pl. Bre. Absts.*, viii., **2**, 1938, p. 155.) An article dealing mainly with the improvement by selection within the varieties Pima and Maarad which were among the Egyptian forms imported into the U.S.S.R. In order to increase the size of the boll crosses have been made between Egyptian cotton and the perennial

species *Gossypium peruvianum*, which, however, being sterile under Russian conditions, had to be grown under short day illumination (nine hours) in order to obtain the cross and an F_2. In the F_1 the boll was of intermediate size, while in the F_2 2-3 per cent. of the annual plants had larger bolls, the female parent in these cases being the perennial species. On sowing seeds from the plants with larger bolls separately segregation occurred in the F_3 and 12-15 per cent. of the progeny had large bolls. In F_5 lines with this characteristic as well as earliness have been obtained. It is hoped that ultimately a variety combining these features with other desirable characteristics of Egyptian cotton will be produced.

[*Cf.* Abstr. 722, Vol. XIV., of this Review.)

389. New Cotton Varieties from a Species Cross. Mysore Cottons and Their Improvement—II. V. N. Ranganatha Rao. (*J. Hered.*, 28, 1937, p. 311. From *Pl. Bre. Absts.*, viii., 2, 1938, p. 156.) A brief survey of early work on interspecific crosses within indigenous Indian cottons is given. The object of the present work was to develop a variety equalling Broach cotton in quality and suitable for cultivation under Mysore conditions. *Gossypium herbaceum*, Kumpta variety, selection 69, with yellow corolla, fuzzy seeds and shallow, broad-lobed leaf was crossed with *G. arboreum*, with red corolla, green seeds and deep, narrow-lobed leaf. The corolla colour, seed colour and leaf shape of *G. arboreum* were dominant in the F_1 and in the later generations selection for such useful characters as earliness, low fruiting branches, ginning outturn and lint quality was pursued in the eight possible classes given by the different combinations of the dominant and recessive conditions for the corolla, seed and leaf characters. Two valuable new strains have been produced and the qualities of one of these, H.190, warrant its distribution to the growers. It has a yellow corolla, broadly lobed leaf and green seeds, a staple length of $\frac{7}{8}$ inch to 1 inch, a yield of 300-350 lb. of seed cotton per acre, a ginning outturn of 30 per cent., good quality and good class lint spinning 32s. to 35s. giving a test of 80/85 lb. at 19s. and with a good white colour. It is susceptible to wilt, but the selection of a wilt resistant strain is in progress. Its green seeds enable it to be identified in the field after the fruit has opened. The other selection, strain 19, has a broad-lobed leaf, red corolla, green seeds and a ginning outturn of 30 per cent., but its yield on a field scale has yet to be determined.

390. S×P Cotton in Comparison with Pima. (*Egyptian Cott. Year Book*, 1936-37, p. 109.) S×P is an American cross between Sakel and Pima cottons. This paper gives a short history of the variety; discusses the superiority of S×P over Pima from the producers' standpoint; compares the lint characters of and the yarns made from S×P and Pima; and gives the opinions of American and European spinners and manufacturers on the value of this variety.

391. Inheritance of Okra-Leaf and Round-Leaf in Upland Cotton. A Note on Brown's and Cotton's Data. By T. R. Richmond and R. E. Harper. (*J. Hered.*, 28, 1937, p. 215. From *Pl. Bre. Absts.*, viii., 2, 1938, p. 157.) The authors point out that the results obtained by Brown and Cotton can be explained by the assumption that the round leaf of their mutant is governed by a single recessive factor (*rl*) segregating independently of the factor pair O_o (okra leaf)—O_n (normal leaf).

FIBRES, YARNS, SPINNING, WEAVING, ETC.

392. Methods for the Measurement of Certain Character Properties of Raw Cotton. By H. B. Richardson *et al.* (*U.S. Dpt. Agr., Tech. Bull.*, 545, 1937. From *Exp. Sta. Rec.*, 77, 3, 1937, p. 329.) Detailed improvements in

methods for measuring strength, fineness, and maturity of cotton fibre are described; the merits and demerits of certain procedures previously used are pointed out; and relevant literature reviewed.

The Chandler bundle method for determining strength has been studied carefully, and the technique more completely specified. Variables now controlled or corrected include distance between threads at the centre of the bundle, size of bundle, manner and amount of combing, and elongation of wrapping thread during wrapping of the bundle. The effect of sag of the bundle during wrapping is recognized and approximately evaluated. The calculation of the strength to an imaginary rod of pure cellulose has been abandoned, the results now being calculated to the area of the bundle cross section as determined by wrapping.

Improvements in the weight-per-unit-length method for estimating fibre fineness for a sample of lint include the use of entire fibres instead of cut sections, systematic sampling from all groups of fibre length in the sample, accurate weighting of the fineness in each length group in proportion to the fraction which that group contributes to the whole, and provision for a useful measure of variation of fibre fineness in the sample.

The improvements made in the Clegg method for estimating fibre maturity in a sample of lint include a more extensive and adequate sampling process, sampling from all principal length groups of the length array, classification of fibre-wall types into two groups depending on ratio of lumen width to wall thickness, weighting of percentage of immature fibres of each group according to the fraction which that group contributes to the whole sample, and in simplification of the expression for maturity into a single figure—the immaturity count.

393. Raw Cotton: Spinning Value. By E. H. Helliwell. (*Cotton*, U.S., 101, 9, 1937, p. 66. From *Summ. of Curr. Lit.*, xvii., 22, 1937, p. 686.) A simple statement of some factors, judged by graders, that affect the spinning value of cotton. On the use of stapling test machines, the writer says that the combing and stretching with forceps often result in an apparent increase of about 6-10 per cent. in staple.

394. Cotton Fibres: Structure. By W. K. Farr. (*J. Phys. Chem.*, 41, 1937, p. 987. From *Summ. of Curr. Lit.*, xviii., 1, 1938, p. 15.) A statement of the author's views on the structure of cotton fibres as cellulose particles embedded in a colloidal matrix. Her evidence is based on the appearance of fibres under the disintegrating effects of acids.

395. Une Méthode d'Appréciation du Coton-Graines. By L. Soyer. (Pubn. No. 14, *Ser Tech.*, Inst., Nat. Agr. du Congo Belge, 1937.) A discussion of the various characters of seed cotton—length and regularity of fibres, ginning outturn, etc.—and of cottonseed, which can be employed as a criterion of value.

396. The Effect of Twist on the Strength and Length of Cotton Fibre. By H. Navkal and N. Ahmad. (*Tech. Bull. Ser. B.* 22, Ind. Cent. Cott. Comm., 1937. From *Summ. of Curr. Lit.*, xviii., 3, 1938, p. 72.) As a contribution to the problem of the relationship between yarn strength and fibre strength the authors have measured the breaking loads of fibres from five Indian cottons under varying degrees of torsion and also the contractions on twisting. The apparatus used was a modification of Barratt's fibre balance, with a device for twisting the fibre, driven through a reduction gear, and a microscope with micrometer for measuring changes in length. The main conclusions drawn from the measurements are summarised as follows: The frequency distributions of strength values are best represented by Pearson's Type I curve, and twisting does

not alter the shape of the curve. The combined results indicate that left-handed twist has a slightly greater effect than right-handed twist. For Cambodia Co. 1 cotton, mean fibre strength is unchanged up to 25 turns, and then increases by a small amount to a steady value at about 200 twists per inch. For the other cottons strength increases by about 3-9 per cent. to a maximum at a twist that varies from cotton to cotton, and then decreases with increasing twist; the fall in strength at about 250 turns per inch is greatest for the shortest cotton. Variability in strength is nearly constant up to 50 turns per inch, but is significantly higher at 100 turns for the shorter cottons. Contraction occurs on twisting and is rapid after medium twist and greater for the shorter cottons. There is no correlation between strength and contraction on twisting, from which it is inferred that in many cases the fibre does not break at its thinnest point. The increase in strength on twisting, within the usual limits of cotton spinning, can account for only a little of the increase in yarn strength observed for the same range of twist. The molecular chain theory of cellulose structure helps to explain the effects.

397. Cotton Fibres: X-Ray Structure and Tensile Strength. By W. A. Sisson. (*Text. Res.*, 7, 1937, p. 425. From *Summ. of Curr. Lit.*, xvii., **22,** 1937, p. 686.) The method of X-ray analysis due to Sisson and Clark, providing a quantitative measure of orientation in cotton fibres, has been simplified and improved, and is now shown to offer the possibility of predicting quality in cotton. A calibration between tensile strength and X-ray data (angle of 40 per cent. maximum density on the 002 diffraction ring) was obtained with four types of cotton, and used to calculate the strength of six other samples. The samples were prepared as for the Chandler bundle-strength test, a small gap being left unwrapped for the X-ray analysis. A table records the observed and calculated Chandler bundle-strengths for the ten samples and the X-ray angles, and the observed and calculated strengths are plotted. The correlation coefficient is $+0·970$. Another set of twenty-one samples gave a curve of somewhat different slope and a correlation coefficient of $+0·867$.

398. Length Regularity and Percentage of Short Fibres in Cotton. (*Ind. J. of Agr. Sci.*, vii., **6,** 1937, p. 935.) A new attachment has been designed by Messrs. Ahmad and Nanjundayya to be fitted to their stapling apparatus, by means of which the proportion of fibres of different lengths in a sample of cotton, and the percentage of fibres shorter than a prescribed limit present in a sample, can be determined.

[*Cf.* Abstr. **345,** Vol. XIV., of this Review.]

399. Cotton Fibre: Effect of Steam on Reactivity. By — Haller. (*Klepzig's Textil Z.*, 40, 1937, p. 273. From *Summ. of Curr. Lit.*, xvii., **23,** 1937, p. 715.) No change in microscopical appearance occurred when raw or bleached cotton was steamed for five minutes. The wetting power and affinity for iodine of the raw cotton were increased, and with both supplies affinity for indigo was greatly decreased. The intensity of Congo-red dyeing of the steamed fibre was greater than that of unsteamed mercerized fibre. Steaming for one hour at 0·5 and 1 atm. gave the same results as obtained in flowing steam, but steaming at 5 atm. resulted in structural changes.

400. Cotton Fibre Models. By R. Reumuth. (*Klepzig's Text. Z.*, 40, 1937, p. 621. From *J. Text. Inst.*, xxix., **1,** 1938, A39.) Photographs are given of models of the cotton fibre and of a wool fibre for comparison.

401. Cotton Fibre: Affinity for Dyes. By P. P. Viktorov and E. O. Vil'dt. (*J. App. Chem.*, U.S.S.R., ix., 1936, p. 1649. From *J. Text. Inst.*, xxviii., **12** ,1937,

A698.) The influence of the minor ingredients in cotton on its affinity for dyes is discussed. Removal of fat and wax by solvents had no effect on dyeing properties. Boiling with water until the reaction for sugar was negative was the most effective means of increasing the adsorption. A subsequent treatment with Na hypochlorite caused a fall in N-content and also in dye adsorption.

402. COTTON HAIR GROWTH RINGS: STRUCTURE. By T. Kerr. (*Protoplasma*, 27, 1937, p. 229. From *Summ. of Curr. Lit.*, xvii., **21**, 1937, p. 660.) The appearance of layering in swollen cotton hairs is due to a structural differentiation of the cellulose into alternate compact, strongly birefringent zones and more porous, comparatively isotropic lamellæ. During the deposition of the secondary wall, two lamellæ, one compact and one more porous, are deposited every twenty-four hours, these two comprising a daily growth ring. The rings show considerable variability in width and density of the more porous lamellæ, the latter being correlated with fluctuations of night temperature. When the temperature falls below 20° C., the porous zones do not stain in Congo red and are well differentiated from the contiguous compact lamellæ, but if the night temperature remains above 22° the porous zones are poorly differentiated and stain heavily. The conclusion is drawn that the compact zones are laid down during the day and the porous zones at night. The width of the daily deposit varies within wide limits; cotton from North Carolina, with a boll period of fifty days, had rings 0·30-0·35 μ thick, whereas cotton grown in Massachusetts, with a boll period of seventy-five days, had rings 0·12 μ thick. "Green lint" cotton has a non-cellulosic constituent in the secondary wall, insoluble in cuprammonium solution or 72 per cent. sulphuric acid, and accumulating in the interstices of the more porous lamellæ.

403. TEXTILE FIBRES: MICROBIOLOGY. By L. D. Galloway. (*Text Rec.*, lv., **654**, 1937, p. 32. From *Summ. of Curr. Lit.*, xxvi., **22**, 1937, p. 686.) A brief review, with literature citations, on the incidence of fungal and bacterial damage in cotton, flax, jute, hemp, manila, ramie, silk and rayon fibres.

404. LINTERS: ACETYLATION: INFLUENCE OF PROPERTIES. By M. Swerdlin. (*Prom. organ. Chimii*, 2, 1936. From *J. Text. Inst.*, xxviii., **11**, 1937, A598.) The influence of various characteristics of linters on the properties of cellulose acetate prepared from them has been examined. (1) The viscosity of the linters in cuprammonium (relative viscosity of 1 per cent. solution 30-400; specific viscosity of 0·25 per cent. solution 0·9-3·7) is without influence on the cellulose acetate prepared under the same conditions. (2) Linters of the same viscosity will give acetates of various viscosities under different conditions of acetylation. (3) Moisture content being constant (6-7 per cent.), the rate of acetylation under the same conditions is inversely proportional to the viscosity of the linters. (4) There is not a fundamental relation between the viscosity of the linters and the mechanical properties of acetate films produced from them. (5) The transparency of the acetate solution is directly related to the ripeness of the linters or cotton fibre.

405. INTRODUCTION TO THE STUDY OF SPINNING. By W. E. Morton. (Longmans, Green and Co. Price 12s. 6d. Reviewed in *Man. Guar. Coml.*, 21/1/38.) A preliminary survey of the various textile raw materials, and of their conversion into yarn, is followed by a serious of chapters each dealing with one particular textile fibre, describing its sources, variations in quality, spinning properties, uses, and so on. The second section contains chapters on primitive spinning, the development of continuous spinning, carding, roller drafting, and combing. The book is well illustrated, and the descriptions of machinery are most lucid.

406. COTTON YARNS: STRENGTH AND "SUBSTANCE EFFICIENCY." By O. Schmidhäuser. (*Textilberichte*, 18, 1937, p. 567. From *Summ. of Curr. Lit.*, xvii., 20, 1937, p. 626.) The influence of the various fibre properties on the characteristics of yarns is discussed, and a study is made of the "substance efficiency" of cotton yarns. This quantity is defined as the ratio of the actual yarn strength to the theoretical strength obtained by multiplying the fibre strength by the number of fibres in the yarn cross-section. The values for cotton yarns range from 35 to 50 per cent. Tables showing fibre properties and yarn counts, twists, strengths and substance efficiencies for American, Egyptian and other types of cotton are given. The influence of fibre fineness, yarn twist, and injury of fibres during processing are discussed, and curves are given showing the variation in yarn strengths and substance efficiencies with twist.

407. VELAN PF. (*Text. Wkly.*, xx., 505, 1937, p. 601.) Information is given regarding the properties and the method of application of this stain-resisting finishing agent invented by Imperial Chemical Industries. Velan PF can be used on practically all kinds of textile fibres, and will produce finishes resistant not only to washing, including treatment with boiling soap solutions, but also to dry-cleaning.

408. METAL SLIDE MOUNTS FOR MICROSCOPIC OBJECTS. By W. D. Courtney. (*Helminthol. Soc. Wash. Proc.*, 3, No. 2, 1936. From *Exp. Sta Rec.*, 77, 6, 1937, p. 764.) A description is given of the construction of metal slide mounts in which the specimens are held between two cover glasses.

TRADE, PRICES, NEW USES.

409. FACTORS SHAPING THE TREND OF POLICY IN THE COTTON TRADE. By T. Ashurst. (*Text. Wkly.*, xx., 1937, pp. 484, 530, 569.) A report of a lecture dealing with the sources of Empire supplies, the work of the Shirley Institute, conditions in the export market (particularly India), financing of the cotton trade, the adoption of automatic looms, Trade Union restrictions, wage rates, Factory Acts and Social Services, working conditions, trade barriers.

410. A YEAR OF EXPLORATION: THE WORK OF THE LIVERPOOL COTTON ASSOCIATION. By A. C. Nickson. (*Ann. Trade Rev.*, 1937, *Man. Guar. Coml.*, 28/1/38, p. 67.) During the early part of the year an enormous amount of business was transacted in cotton for future delivery and in forward contracts for the sale of cotton on spot terms; with the production, however, of an unusually large American crop, business declined. Owing to the difficulties experienced in connection with the existing future delivery contracts, proposals were made for their alteration, not only the American, but the Egyptian contract also, in order that they might be made to serve as a true hedge for these growths. Other matters discussed in the article include the question of moisture in American and Egyptian cottons, and the increasing cost of cable charges. The Association, which is obviously dependent on the spinning trade, supported all efforts made during the year by the Joint Committee of Cotton Trade Organizations for Government action in support of the cotton industry.

411. COTTON FUTURES. By H. Braun. (*Das Baumwollterminegeschaft*, 1936. From *Exp. Sta. Rec.*, 77, 3, 1937, p. 416.) A study of the elimination of price risks by cotton futures in the cotton trade of North America, with special reference to the German cotton and ready-made goods industries.

412. SEA ISLAND COTTON: NOW USED FOR MOTOR TYRES. (*W. Ind. Comm. Circ.*, lii., 1021, 1937, p. 458.) It is interesting to note that Captain G. E. T.

Eyston, the British racing motorist, who now holds the world's speed record for a twelve hours' run, has his car "Speed of the Wind" fitted with special Dunlop tyres, the cotton in which is West Indian Sea Island. It is probably the first time that Sea Island cotton has been used for this purpose, and Captain Eyston has reported that the tyres are faultless.

MISCELLANEOUS.

413. THE WORLD TEXTILE INDUSTRY: ECONOMIC AND SOCIAL PROBLEMS. Vols. I. and II. (Pubd. in United Kingdom for the Int. Lab. Off. League of Nations, by P. S. King and Son, Ltd., 14, Gt. Smith Street, London, S.W. 1, 1937.) A record of the many matters discussed at the Tripartite Technical Conference held in April last at Washington, D.C., with the object of effecting improvement in the social and economic conditions of the textile industry on a world scale. The first volume discusses the scope and character of the textile industry; sources of raw materials; world textile manufactures; world trade in textiles; over-production and under-consumption; international competition; labour problems. The second volume contains statistics of production, consumption, trade, and labour; and also a record of the proceedings of the Tripartite Technical Conference, lists of members of delegations and committees, and reports adopted, etc.

414. LE COTON: SA PRODUCTION ET SA DISTRIBUTION DANS LE MONDE. I. By Pierre Senay. (Librairie Lepouze, 28, Place de l'Hôtel de Ville, Le Havre. Price fr. 40.) The history and distribution of cotton are first discussed—in which Brazil is considered to be the one country with really large areas now available for cotton. The author follows with a chapter on the botany of the cottons, and then with one dealing with physical characters and commercial classification, with notes on ginning and baling, and on false packing and other malpractices. Pests and diseases are then discussed. A lengthy chapter is devoted to the history and development of cotton cultivation in the United States, dealing with soils and climate, cultural operations, land tenure, costs of production, ginning and baling, etc. Cotton production in Mexico, Central America, and South America is also briefly discussed. The book is furnished with many diagrams and illustrations, and a bibliography of 189 names is included.

CORRESPONDENCE

The following letter has been received by the Editor:

GEZIRA RESEARCH FARM,
MEDANI, SUDAN.
January 15, 1938.

SIR,

Reference your Editorial Note to the title heading of my article on "New Sakel Strains in the Anglo-Egyptian Sudan." My article supplemented that by Mr. Trought (July, 1937) in respect to the "Lecrem" Strain, as well as in respect to the X1530 and X1730 Strains, as reference to the former was unfortunately omitted in his article.

Yours faithfully.
A. R. LAMBERT.

PERSONAL NOTES

We very much regret to announce the death of Mr. H. Astley-Bell, which occurred in Preston on December 14 last. Mr. Astley-Bell had been a member of the Administrative Council of the Corporation since its formation, and for some years also served on the Board of Trustees and on the Executive Committee.

OFFICERS ON LEAVE

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the time of writing the following officers are on leave in this country from cotton-growing countries:

British Honduras	Mr. H. P. Smart.
Ceylon	Mr. G. Harbord.
"	Mr. T. H. Parsons.
Fiji	Mr. H. W. Jack.
Gold Coast	Mr. J. R. E. Hindson.
"	Mr. A. E. Moss.
"	Mr. J. Steele.
Nigeria	Mr. D. W. H. Baker.
"	Mr. G. W. G. Briggs.
"	Mr. K. T. Hartley.
"	Mr. O. S. Swainson.
"	Mr. C. B. Taylor.
"	Mr. C. C. Webster.
Tanganyika Territory	Mr. C. B. Garnett.
" "	Mr. P. J. Greenway.
" "	Mr. C. Harvey.
Uganda	Mr. W. J. M. Irving.

The following officers of the Corporation's staff abroad are also on leave in this country:

South Africa	Mr. P. A. Bowmaker.
"	Mr. F. R. Parnell.
"	Mr. F. S. Parsons.
"	Mr. M. F. Rose.
"	Mr. D. F. Ruston.
Southern Rhodesia	Mr. G. S. Cameron.
West Indies: *Trinidad*	Mr. J. B. Hutchinson.

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FACTORS OF COTTON QUALITY

BY

A. J. TURNER, M.A., D.Sc.
British Cotton Industry Research Association.

WHAT is quality in cotton? And how is the quality of a sample of cotton judged? Simple questions, yet, like many simple questions, far from easy to answer. All interested in cotton are fully aware of its infinite variation; some cotton plants are so only in name, for their seeds are truly naked, whilst others—Sea Island plants—have seeds bearing cotton fibres more than 2 inches long. Between these two extremes come the rest of the world's cottons, wild and cultivated, showing wide differences in every fibre property that can be either measured or estimated—length, grade, fineness, colour, bloom. . . . These differences between types are only a part of the story of variation. Even in a single type there is exceedingly great diversity in the several fibre properties; no two hairs of cotton have exactly the same conditions of growth, and would not therefore be expected to be identical in their fibre properties even in the absence of genetic variation. And when it is remembered that a single boll may contain half a million fibres, and that many factors influence the growth of a boll, wide variation in fibre properties in any commercial variety must be accepted as inevitable.

This variation among cotton fibres is emphasized because it is largely responsible for the difficulty of judging quality. The measurement of the fibre properties, instead of being made on a few fibres, has to be made on a multitude, and great care has to be exercised to see that that multitude is as representative as possible. So sampling demands consideration. It is by no means easy to select representative samples, though fortunately we are more statistically-minded nowadays, and are able to test the representativeness of our samples by means of the statistical tools invented

for the purpose. But all this takes time; moreover, it adds to the complication of the problem, for we no longer have merely to gauge the effect on cotton quality of differences in length, hair weight, wall thickness, etc., but we have also to allow for the fact that the sample has a frequency distribution in each of these fibre properties, not one length, but many lengths, etc. True, we can denote the frequency distribution by additional statistics, but every new term in our equation for the expression of quality adds much to its complexity.

Even a single fibre is a complicated structure. Whilst it has only one length, its hair weight fluctuates along that length, as do most of its other physical properties; the convolutions vary greatly in their density of incidence, and often change direction; even the maturity differs at different parts of the fibre. Furthermore, the individual fibre bears the impress of the cramped conditions of its growth within the boll in the form of innumerable abnormalities representing points of weakness.

In view of such widespread variation in any sample of a single variety it is not surprising that attempts to predict quality from measurements of fibre properties have not yet been crowned with success. They have been founded on simplified versions of the facts. The fibre properties have been represented by single values, usually the mean values, so it is really remarkable that by these means it has been found possible to account for over 80 per cent. of the variation in quality, as indicated by the spinning value.

Mention of spinning value as a measure of quality brings us back to our opening question: What is quality? Undoubtedly cottons are ultimately judged by the quality of the goods made from them. Assuming that the housewife is an infallible judge of the quality of the cotton goods she buys when shopping, we should be able to classify our cottons by reference to the prices commanded by these goods, or more exactly, by the prices paid for the yarns from which these goods are made, making due allowance for the spinning and ancillary costs.

In a general way this is no doubt true, largely because experience has been gained of the different cotton growths which have established reputations in the world's cotton markets. The fact that a particular lot of cotton has been grown in a certain place plays a large part in the fixing of its price. Quality is identified within limits with place of origin; in this way past experience is wedded to present production. Working within the aforesaid limits associated with any particular place of origin, an expert grader has no difficulty

in assessing the value of any particular lot of cotton with a high degree of accuracy. He makes a hand-and-eye examination of samples for the following properties in their order of importance: (1) Length; (2) grade or leafiness, including colour and any bloom or lustre associated with it; (3) character, including strength, drag, hardness or softness.

In dealing with a delivery of say, 2,000 bales, he examines the first few bales for these different properties, taking a number of pulls from the sample from each bale. He thus quickly arrives at a conception of how the cotton is running, and is then able to proceed rapidly with the classing of the remainder of the bales both for grade and staple. In the height of the season an expert cotton classer in the United States is often called on to judge in this way some 1,000 bales a day. Cotton brokers in other markets class their cottons equally rapidly when necessity demands. It will be seen, therefore, that this hand-and-eye method has a tremendous advantage in speed of performance. Some such method would seem to be essential for success in carrying on the activities of the trade in raw cotton, with last year's record world crop amounting to nearly 40 million bales, especially when it is recollected that each bale often passes through many intermediaries, each of whom makes his own tests for quality.

This trade method of judging the quality of cotton does fulfil its purpose; the trade in the vast cotton crop is carried on with the necessary expedition, and it does serve the various interests concerned in a generally satisfactory manner. On the other hand, the method suffers from certain limitations. As already mentioned, the success of the system turns on a knowledge of the place of origin of the cotton and experience of the types of cotton grown there. If, therefore, a new type is bred having characteristics widely different from those which distinguish the type identified with that particular place, there is grave danger that the new variety will be treated as if it came within the limits which tradition and experience have imposed on the old. Such cases are by no means imaginary, as the following examples will suffice to show.

Certain spinners in Bombay, when first turning their attention to Peruvian cotton, were greatly mystified by the fact that in spite of its considerable length it proved a relatively poor spinning cotton. They expected it to spin much better than Punjab-American 289F, but found that it did not do so; they were unfamiliar with the Peruvian cotton and ignorant of its comparative coarseness. Another spinner unfamiliar with the varied types of cotton produced

in West Africa was much disappointed to find that a cotton which had a long staple and pulled well did not give him the yarn that he expected and which he had contracted to deliver; the West African cotton happened to be the coarse Ishan cotton instead of Northern Nigerian, of which alone he had had previous experience. Failure of human judgment in both these cases arose immediately from lack of experience of the type, though fundamentally the difficulty is one of assessing the relative fineness or coarseness of a cotton by sight or touch.

The trade method of valuing a sample of cotton affords a striking contrast with the laboratory method. The "combined stapling test" in use at the Shirley Institute for judging the quality of staple measures three characters: (1) Length; (2) fineness; (3) maturity. The time taken by a single observer in making one combined stapling test is from two to three hours; for accuracy every sample is tested by at least two observers. The quantity of trash or foreign matter present is found by means of the Shirley Analyser, the principle of which takes advantage of the difference in buoyancy of the open lint and the trash by first completely opening the lint by means of a saw-tooth roller (known as a taker-in type of beater), then projecting the whole into a stream-lined air-flow of narrow depth in which the cotton hairs are buoyant, whereas the trash falls through; the lint is collected on a perforated cage and the trash in a convenient settling chamber. These laboratory methods are, of course, more objective than those used in the trade. It will be seen that there is a general correspondence between the properties measured in the two cases if we identify "character" with hair weight and maturity. But the laboratory methods take no cognizance of colour and bloom, and it is rather doubtful whether they always give an indication of bad character in a cotton.

It may be added that investigations of the relation between fibre properties and spinning value have thrown considerable light on the relative importance of length and fineness. For cottons up to 1 inch long, length is of outstanding importance; for longer cottons, fineness becomes of increasing relative importance; and for very long cottons a much greater change is produced in spinning value by a slight change in hair weight per centimetre than by a similar change in length. Fortunately, there is a strong correlation between length and fineness, so that although for cottons longer than 1 inch it is the fineness more than the length that is directly responsible for good spinning performance, yet through its correlation with fineness the length still remains quite a good general measure of quality. This

is a happy accident, seeing that the reverse correlation holds good for wool and other fibres, which have length associated with coarseness. However, the correlation between length and fineness of cotton is by no means invariable, as the existence of the long coarse cottons, Tanguis and Ishan, shows; and the incompleteness of the association acts as a valuable spur to the cotton breeder, who knows that he may still hope to discover fine cottons among his strains that are not over long.

We may now apply these considerations of present-day techniques to attempts to introduce new types of cotton. Certain questions at once arise. First of all, will its agricultural properties render the new type advantageous to the grower if its quality proves satisfactory? Next, what is its quality? What is the grader's judgment on it? What do the results of the combined stapling tests reveal? And, finally, how does it spin and what sort of yarn can be made from it? The last question expresses implicitly the view that yarn quality is the measure of cotton quality. As a measure of the intrinsic quality of a cotton the spinning test has, in fact, found wide acceptance.

At first sight the spinning test is a much more complicated method of judging the quality of a cotton sample than either the grader's method or the laboratory measurements of the fibre properties. In it the sample may pass through sixteen or more machines, several of which have to be set with special regard to the particular sample; and the quality of the yarn has still to be determined before judgment is pronounced on the quality of the cotton. It might, therefore, be thought that the spinning test is subject to even more arbitrary judgment than the inspection of the cotton, and that it introduces more variables than fibre testing. Nevertheless, cotton is bought and sold to undergo spinning, so the spinning test is a "practical test," and experience proves it to be the best guide available to the results of commercial spinnings. It has indeed been long accepted as the best measure of the quality of new cottons produced by the officers of the Empire Cotton Growing Corporation, this work having been centred at the Shirley Institute for many years past. Spinning tests have similarly been carried out on long staple and other cottons by the Research Laboratories of the Fine Cotton Spinners' and Doublers' Association, Manchester; on Indian cottons at the Indian Central Cotton Committee Technological Laboratory in Bombay; on American cottons in College and other laboratories working under or in collaboration with the United States Department of Agriculture; and recently

on Egyptian types of cotton at the Spinning Laboratory at Giza.

Special techniques have been worked out for these spinning tests which are generally based on the results attained by processing 10 lb. or even 5 lb. of cotton on spinning machines of the standard type used in the industry. The cotton sample is spun to various counts of yarn with standard twists and under standard conditions, and these yarns are tested for strength and examined for appearance. The test for strength is largely objective; but it has not yet been found possible to exclude the subjective element from the judgment of appearance. However, the fact that the cotton can be spun at all in an economic manner to certain "highest standard warp counts" is itself at once a very valuable index of the quality of the cotton; still, those features which contribute to the yarn appearance —its neppiness, levelness, colour, and hairiness—constitute most important elements of quality in the yarn and therefore in the cotton. Neppiness is a particularly undesirable feature; it is sometimes, but not always, associated with immaturity, and neps due to entanglements of immature hairs are anathema to the merchant, since the appearance of an otherwise excellent cloth may be completely ruined, such neps often showing up most unpleasantly in self-coloured fabrics.

"Process neps"—those consisting of mature hairs bundled together in the processing through the machinery, and presumably due to inefficient action of the machinery—would not show the same ill-effect in dyeing. Nevertheless they disfigure the appearance of grey and bleached cloths, especially when magnified by a calender finish often given to these cloths; such neps must therefore be regarded as detrimental, though this defect cannot rightly be laid at the door of the quality of the cotton. Such process neps should not occur in the spinning test, in which the machinery and the processing should evidently be the best possible.

A point of some difficulty arises in connection with "dead neps" or "mixed neps," which owe their inception to dead or immature hairs; whilst such neps, when they occur, must be attributed to dead hairs in the cotton, the converse does not hold good, for some immature cottons give yarn that is practically nep-free. Unfortunately, at the moment, there is no means of predicting from an examination of the cotton itself whether an immature cotton will or will not give rise to dead neps in the yarn.

Another feature detrimental to the appearance of the yarn is the presence of small leaf and seed particles. Although the majority

of the impurities are successfully removed by the cleaning machines in the spinning sequence, cotton that is very trashy in the raw state cannot ordinarily be cleaned to the same pitch as cotton that is comparatively clean at the outset; the yarn shows the impurity of its origin, and the cotton is depreciated accordingly. The limitations of climate or geography cannot be entirely circumvented, but where these lead to difficulties in picking the cotton clean it is evident that those varieties which give the least trouble in this respect are to be preferred.

After a new type of cotton has done well in the spinning test, what next? If it is satisfactory agriculturally, there comes the problem of getting it taken up by the cotton market and the spinner. It has to run the gauntlet of trade appraisement, and some natural psychological resistance to the impact of a new type must obviously be expected. Arriving on the market as a new cotton from a known cotton-growing area, it will almost certainly be valued in terms of the other growths from that area; and if it is of the same general type—an improved derivative of a standard growth, particularly if the improvement is in the direction of longer staple—the new cotton is likely to receive a welcome and due recognition of its worth. On the other hand, if the new cotton is out of character with the well-known growths of the area, more difficulty is likely to arise in obtaining a true monetary appreciation of its value, and a longer time will elapse before it finds its feet in the cotton market. The spinner has to be convinced that the new growth will suit his particular qualities of yarn as satisfactorily as the type he is called on to relinquish. He is rightly somewhat suspicious of the "parvenu" cotton. Even if he does find it satisfactory technically, he wonders whether sufficient supplies will be available for him to be able to place the yarn continually on offer. The only thing he knows for certain is that the new cotton invites him to submit to the hazards of the unknown; he has to balance a problematical small gain against a possible large loss.

In a large mill of say, 100,000 spindles, changing over from one type of cotton to another demands considerable organization, as all the machines have to be kept constantly supplied with cotton in order that production may not suffer. In a fine spinning mill a fortnight may elapse before the cotton which is taken into production in the cotton room is removed from the spinning mule as spun yarn. And if the decision to go on to a new cotton is acted on, but turns out ultimately to have been an "error of judgment," the resulting financial loss is bound to prove considerable. Of

course, every precaution would be taken against such a contingency by using the new type on only a part of the machinery in the first place.

It is perhaps a fair summing-up of the present position to say that as far as the short and medium staples are concerned the improvement in cotton quality likely to prove immediately the most remunerative to the grower is one of staple, as it is certainly easier to obtain a premium for greater length of staple than for any other improvement in quality. Apart from a greater cleanliness where possible, the next desideratum is the avoidance of neppiness. It is an advantage if the new type is in line with the old; it should not only be good in spinning, but also appear good to the eye and hand. A good broker's report forms a useful passport to the cotton in its passage from the grower to the spinner; the hand-and-eye method of examining cotton is not likely to lose its place as the day-to-day method of dealing with the cotton crop on its way from the producer to the user. On the other hand, the tests of fibre properties and the spinning tests have not only become the tests *in excelsis* for assessing new cottons, they have also found a very definite and highly useful niche as supplementary and even crucial tests which many firms use with profit. These physical tests have their proper place as a kind of "Court of Appeal"; whilst they cannot rival the hand-and-eye method for speed, they alone make it possible to obtain, season after season for any particular growth, objective records which can be duly preserved and which become increasingly useful as they accumulate. It is by means of these and other physical methods that full understanding of the relation between the properties of a cotton and the processes of spinning will, it is hoped, ultimately be won.

Received May, 1938.

THE ORIGIN OF CULTIVATED COTTON

BY

R. RUGGLES GATES, D.Sc., LL.D., F.R.S.

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It is not proposed in this article to solve the problem of the origin of the cultivated American cottons, but rather to point out some of the advances which have been made towards a solution based on recent cytological and genetical work. The genus Gossypium is a large one, and quite a number of its many species have been utilized independently by aboriginal peoples in widely separated parts of the world. They must have noticed the possibilities of its long lint hairs for use as thread. Primitive spinning operations would be developed, and ultimately methods of weaving the thread into textiles would be acquired.

Zaitzev, in 1928, from extensive comparative studies of cottons from all parts of the world, emphasized a well-known feature of the "cotton belt," that cottons occur naturally in tropical savannahs and partly in the transitional regions from savannah to forest. Their ecological requirements also include a rainfall of 40 to 60 inches, and strong sunlight for satisfactory growth. Some wild species are decidedly xerophytic, while *G. tomentosum* in Hawaii is an extreme xerophyte. Zaitzev concluded that cotton species have been independently brought into cultivation by man in four separate regions, two in the Old World, and two in the New—*i.e.*, Indo-China, Africa, Central America and South America, the three original centres of cotton-growing being India, Mexico and Peru. He leaves out of consideration the Australian species, *G. Sturtii*, with twenty-six chromosomes, and *G. Robinsonii*, regarding which very little is known. Applying the conceptions of Vavilov, he finds that the cotton species of these four regions show numerous parallel series of characters or homologous variations, which have often led to mistaken conceptions of near relationships between forms native to different continents. From such similarities the conclusion has also been drawn that characters have been naturally transferred from one group to another widely sundered species by some hypothetical process of hybridization. This parallelism in variation is undoubtedly of greater importance than has yet been realized. Zaitzev found the parallelisms to be between (1) the species of Central America and

those of Africa, (2) South American and Indo-Chinese species. The latter include *Gossypium arboreum* from India, *G. Nanking* from China, and *G. obtusifolium* described by Roxburgh from Ceylon, to which may be added *G. neglectum* of Burma, and *G. cernuum*, native of Assam, which has larger bolls than any other Asiatic cotton.

Man has also tended, especially in modern cotton growing, to pass from the perennial arboreal types with mainly monopodial branching, originally grown nearer the Equator, to the annual, bushy types with sympodial branching, the latter being introduced into sub-tropical regions far from their natural habitats.

Another fact which has a bearing on the question of the origin of the New World cottons is that new American species are still being described from time to time. For instance, Cook and Hubbard, in 1926, described five new species of Gossypium from Mexico. Some of the species are small trees 10 or 12 feet high, while one, *G. dicladum*, is herbaceous, with white flowers having a red spot at the claw of the petal. The seeds of these species are naked except for a tuft of fuzz, the lint being sparse and generally less than an inch in length; *G. Morrilli* has lint ⅞ inch long.

The same authors described five new species from the West coast of South America, in Colombia and Ecuador, which are not closely related to the Mexican species. One of these (*G. tridens*) reaches 15 feet in height and 4 inches in diameter of the trunk. *G. quinacre*, described from a single plant, is robust, over 6 feet high, and is regarded as probably related to Sea Island cotton. So far as I know, none of these forms has been studied either genetically or cytologically. They are of interest as indicating the large number of wild forms which exist in America, although none of these except, perhaps, *G. quinacre*, could have been of possible use as a source of cotton fibre. Various wild species may also have crossed with cottons in primitive cultivation, thus increasing the difficulty of delimiting original forms.

The problem of greatest significance and importance is, of course, the origin of the so-called New World cultivated cottons having $2n=52$ as their chromosome number. Since Denham in 1924 examined *G. barbadense* (Egyptian) and a cotton collected in the interior of Colombia, and discovered that these species have 52 chromosomes, while the Asiatic species have 26, a group of American wild species also having 26 has been discovered. They are native to Southern California, Mexico and adjacent regions, including such species as *G. Davidsonii*, *G. armourianum*, *G. Klotschianum* and *G. Harknessii*, but as they have little or no lint they have by some

authors been excluded from the genus altogether. Furthermore, the number of known tetraploid species ($2n=52$) has been considerably extended to include *G. purpurascens* from Hayti and the Lesser Antilles, *G. Darwinii* from the Galapagos, *G. tomentosum* from Hawaii, *G. taitense* from Fiji and the Marquesas (also doubtfully reported from Tahiti, the Philippines, Rodriguez and Madagascar), as well as *G. mexicanum* and *G. brasiliense*. From what we know of polyploidy or chromosome multiples in plants, it is improbable that all these species with 52 chromosomes have arisen from a single source. But, in any case, it appears that tetraploid species with 52 chromosomes were already at hand, both in North and South America, for primitive man to select, unless, as is unlikely, *G. mexicanum*, *G. brasiliense* and others arose after human interference began. Investigators have been generally agreed that the tetraploid species are allopolyploids—*i.e.*, that they have arisen through a doubling of the chromosomes in a sterile hybrid between two diploid species with $2n=26$ chromosomes. The parent species may have been more nearly related in certain crosses, and more widely separated in others. Skovsted, from his cytological investigations, puts forward the view that these tetraploid species form a more closely related group than either the American diploids or the Old World species, but this cannot be regarded as a safe conclusion on the present evidence. His view is based mainly on the relatively regular pairing of the chromosomes in meiosis (reduction division) in the hybrids between tetraploid species. But recent work indicates strongly that failure of pairing, and consequent hybrid sterility, depends upon rearrangements of the chromatin material rather than upon the number of gene mutations. Hence, it is possible for a great deal of specific differentiation to take place with very little resulting interspecific sterility. The geographical distribution of the tetraploids, from Brazil and Mexico to Galapagos, Hawaii and Fiji, not considering the doubtful attribution of the wild cottons in the Philippines and Madagascar, indicates also that they have a much wider range than the American diploids.

The extensive genetical results of Harland are markedly at variance with the view that these tetraploid New World cottons form a compact or recent group. On the contrary, he suggests that they arose as early as the Cretaceous period, on the eastern part of some land connection between South America and Polynesia. He concludes that *G. Darwinii*, *G. taitense* and *G. tomentosum* must, in any case, have been separated from the South American species for several millions of years. By extensive crosses between Upland

(*G. hirsutum*), and Egyptian cotton (*G. barbadense*), he shows that the morphological and physiological differences are profound, and that they have been isolated from each other over a long period. While the varietal differences within each species, such as red petal spot or yellow-cream corolla, behave as simple Mendelian differences, the same characters in crosses between these species give complicated " blended " inheritance. Though the differences are shown to be allelomorphic—*i.e.*, determined by homologous loci in the chromosomes of the two species—yet their expression is greatly affected by the presence of quite different complexes of modifiers in the two species.

Other evidence of long separation, or, indeed, independent origin, of these tetraploid species, is contained in the fact that, although nineteen factors in the Hawaiian *G. tomentosum* appear to have identical loci with those of other species, yet this species has two genes found nowhere else—viz., (1) khaki lint, (2) hairy plant body. Similarly *G. Darwinii*, which is nearer to *G. hirsutum* and *G. purpurascens* than to *G. tomentosum*, has three new genes,(1) red plant body, (2) yellow corolla, (3) laciniate leaf. *G. taitense* from Fiji is also regarded as morphologically close to *G. hirsutum* and *G. purpurascens*.

The fact that *G. hirsutum* and *G. barbadense* have relatively few genes in common may be explained by geographical isolation over a long period, but this period would be much shortened if these two species originated independently through chromosome doubling in hybrids between different diploid species.

A closer examination of the question of the origin of the tetraploid species requires the application of recent cytological knowledge. From chromosome measurements and observations, Skovsted concluded that Old World species such as *G. Sturtii* and *G. Stocksii* had larger chromosomes than the American diploids such as *G. Davidsonii* and *G. armourianum*. Such a difference appears to be clear, at least in certain cases. He then measured the chromosomes of the American tetraploids and concluded that they contained a set of smaller and a set of larger chromosomes. On this evidence he concluded that the American tetraploids arose from doubling of the chromosomes in crosses between an Asiatic and an American diploid. This question of chromosome sizes has been examined by Arutjunova, who makes a comparison of the chromosomes of *G. herbaceum* with *G. hirsutum*. She finds that the thirteen pairs of chromosomes in *G. herbaceum* form a graded series from the longest to the shortest, and that two pairs have satellites* attached to them.

* These are minute globular bodies which are now known to be concerned in the formation of the nucleolus.

In the tetraploid *G. hirsutum* she finds the 52 chromosomes somewhat smaller than in *G. herbaceum*, but a graded series of sizes appears here also, only there are four instead of two belonging to each chromosome type. She was, however, only able to identify 6 chromosomes with satellites, but these bodies are often very difficult to find on account of their minute size, and we know that under certain conditions they can disappear. She therefore concludes that the hypothesis that the tetraploid cottons have two distinct sets of chromosomes, a larger and a smaller, is without foundation.

If that is the case, there is no sufficient basis for Skovsted's hypothesis that the tetraploid cottons arose from crosses between an Asiatic and an American diploid species. One would conclude rather, from the close similarity in the four sets of chromosomes making up the 52, that the parent species were more nearly related. It is even conceivable on this evidence that certain tetraploids arose through doubling of the chromosomes without previous crossing. This condition, known as autotetraploidy, is well known in many plants. Further evidence on the question of autopolyploidy or allopolyploidy can be obtained from more critical studies of the chromosomes. Arutjunova finds that the two pairs of satellites in *Gossypium herbaceum* differ in size. This is an indication in favour of the view already held on other grounds, that the 26 chromosomes of the diploid cottons represent a secondary condition derived from a lower ancestral number.

Davie, in 1935, concluded that 7 was the primitive chromosome number of the Malvaceæ, the family to which cotton belongs. This was based on the occurrence of 7 or its higher multiples in such genera as Lavatera, Malva, Malvastrum, Kitaibelia and Pavonia. In Malva all the species yet examined have $2n=42$—*i.e.*, the species are hexaploid, with six sets of 7. The genera Gossypium, Thespesia, Thurberia, Shantzia, and Sidalcea, all have 13 as fundamental number. It seems clear that the latter number has been derived at some time from 7, and this change may have occurred independently more than once.

Cytological evidence of different kinds is now available for determining how and when such changes took place. What is known as secondary pairing of the chromosome pairs in meiosis takes place when there has been an earlier doubling of the chromosomes, either with or without the subsequent loss of certain chromosomes. The chromosomes move in a viscous medium, and similar ones can only become paired when they happen to come within each other's spheres of attraction. The maximum amount of secondary

pairing will therefore indicate how many chromosomes are really represented in the plant four times instead of twice.

Now Davie found cases in which the 13 chromosome pairs arranged themselves in six pairs with one single, indicating that 7 was the previous fundamental number, and Skovsted showed the same arrangement in one of his published photographs. Skovsted has, however, found in two cells a group of three bodies in addition to various pairs, indicating that the previous chromosome number was 6, the constitution of the 13 chromosomes in cotton being A A A, B B, C C, D D, E E, F F. This is supported by finding that the genera Gossypioides and Kokia, allied to Gossypium, have $2n=24$. It may therefore be that, in the ancestry of cotton, 6 is a transitional number between the earlier 7 and the later 13. These alternatives can be further investigated by a study of the satellites attached to the chromosomes in the various species, and the number of nucleoli which are produced in each.

Finally, reference (previously overlooked) may be made to a recent classification of the cottons of Asia and Africa (*Ind. Jour. Agr. Sci.*, VII, 2, 1937) by Hutchinson and Ghose, in which much of the confusion in nomenclature and relationships is cleared up. It is pointed out that the indigenous cottons of Africa are closely related to those of India and that the exotic African types are of species acclimatized to India. The authors accept Harland's scheme of three New World types, *G. hirsutum* L. (Upland), *G. barbadense* L. (Sea Island) and *G. religiosum* L. (Bourbon). In the last species is included *G. purpurascens* Poir. The Central American group of Zaitzev is thus divided into Upland and Bourbon types. The present writers also include *G. mexicanum* Todaro in *G. hirsutum*, as well as placing *G. brasiliense* Macf. and *G. peruvianum* Cav. in *G. barbadense*. Certain other species are also merged.

Authors may perhaps differ about some of these mergings, but they are particularly useful at the present juncture as giving clear indications of relationships. *G. triphyllum* Engl., of South-West Africa, is regarded as a Gossypium, probably related to *G. anomalum* Wawra and Peyr., of Angola, French Sudan and Somaliland. *G. arboreum* is divided into var. *typica* and var. *neglectum*, each with forms *bengalensis*, *burmanica*, *indica* and *soudanensis* ; as well as var. *cernuum* for the Assam plant. Such cross relationships extending from Burma to the Sudan, would indicate either parallel mutations or transport of types by man.

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COTTON IN NYASALAND

BY

H. C. DUCKER.

This is the third of a series of articles which have been published in the Review (see "Cotton in Nyasaland," Vol. VI., No. 4, and Vol. IX., No. 3), and brings up to date an account of the cotton crop in Nyasaland during the past fifteen years.

The second article ended on a note of optimism. It is intended now to indicate in what measure this optimism has been justified, to tell in brief what appears to be needed to consolidate the position gained by cotton in this country, and to ensure that its development proceeds unhindered to the fullest extent to which conditions will allow. The various improvements in transport, sketched in the second article, have come to pass in the six years since that article was written. The northern extension of the Nyasaland railways was opened to traffic in 1934-35, and the M.V. *Mpasa,* a most useful cargo vessel, has been added to the Lake Service. The country has now a main line of communication extending from the extreme north at Karonga, via ship and railway, to the sea at Beira. During the same period improvements have been made in the feeder road services which give access from the hinterland to this main route. In particular, an all-weather road has been built which connects Lilongwe, the centre of the rich agricultural plateau area of the Central Province, to the rail-head at Salima, near Domira Bay. This road also serves Fort Jameson in Northern Rhodesia, and has halved the distance to rail-head for that area. A rise in the Lake level having made the Domira Bay anchorage unapproachable by land, access to the Lake was provided by a short branch line to Chipoka, some seventeen miles south of Salima. The railway authorities have encouraged the development of cotton in the Lake shore areas and elsewhere by a policy of low freight rates on seed cotton from market to ginnery, and have also maintained an all-in rate for baled lint from any part of the Lake basin to Beira at the moderate level of £5 per ton, rates from intermediate points being charged proportionately lower with the decrease in distance from the coast.

The moderate rates charged have done much to help development, but if low prices for cotton prevail as at present (American Middling was quoted at 4·80d. at Liverpool on April 5th, 1938) further revision may be necessary.

The physical obstacles of transport to the development of cotton production have been largely removed and are problems of the past.

In commercial cotton growing the tendency towards native production becoming paramount, as described previously, has continued. But there has been a revival of estate interests on new lines. Cotton grown with the aid of hired labour has not come back to any extent, but many European-owned estates have turned over to native tenant production, on the lines adopted in large measure by the dark tobacco industry.

This method has much to recommend it, since it enables alienated land to be put back into cotton production. The return per tenant and family is higher than that of a native and his family working on their own garden on Native Trust land, since on the estate they are subject to some discipline, making for better and more extensive cultivation, while there is no doubt about the educative value to the general run of growers of well-cultivated tenant cotton gardens.

The success of an estate cultivated by native tenants depends very largely on whether a good balance of crops is maintained. Without this, various pests and diseases may become limiting factors, and too much emphasis on cotton production may endanger food supplies.

Crop results for the six years under review are as follows:

In Bales of 400 lbs. Weight Lint.

	European (Mainly Tenants).	*Native (Trust Land).*	*Totals.*
*1932	95	4,972	5,067
†1933	190	5,752	5,942
‡1934	650	10,063	10,713
1935	565	20,441	21,006
1936	1,054	12,676	13,730
1937	1,996	11,912	13,908

It will be seen that from 1932 to 1935 there was a rapid increase in production, followed by a sharp decline in 1936 and 1937. The increase took place during a time of rising prices, and was helped by good yields per acre due to the introduction of U4 cotton. The

* Crop confined to Lower Shire, Chikwawa and Central Shire.

† Whole country supplied with seed of U4 origin.

‡ Lake shore areas commencing large scale production.

decrease in 1936 occurred while prices were still high and when seed issues had been even higher than in 1935. In 1937 returns were again poor, though seed issues and acreage sown had again been at a high level. Prices did not commence to drop seriously till well after the middle of the year, when they could have had but little effect on production.

The explanation of this decrease lay in the activities of the Red or Sudan bollworm, *Diparopsis castanea*, Hamps., which became once more a major pest of cotton. This bollworm, which appears to be an immigrant into Nyasaland from south of the Zambesi, has no known host plant other than cotton in this country. There are no true wild cottons in Nyasaland, and the pest is maintained, so far as is known, entirely on the cultivated crop. It is therefore singularly free from parasitic control, and given the opportunity can breed up in numbers sufficient practically to destroy the entire crop. Such destruction occurred in many areas in 1936-37, and, as described in the 1936-37 Progress Report, the Domira Bay Station suffered acutely in that year from red bollworm attack. The yield of one strain for example, Z14, was reduced to 84 lbs. of dirty seed cotton per acre, compared with yields of 700-1000 lbs. of good quality seed cotton per acre which had been obtained in previous years. The experience of the European estate days was being repeated, and for many reasons similar to those that they provided, an epidemic had developed.

To obtain the record yield of 1935, the largest possible acreage which conditions would allow was put under cotton at all possible dates of planting. There was a strong tendency for gardens to coalesce, to become large and unwieldy, and so to make for a bad crop balance in certain areas, while the implications of time of planting propaganda, in relation to a close season, were neglected by certain interests. As a result, a vast population of red bollworm was bred up which played havoc with the crop under the climatic conditions of 1936 that were so favourable to the pest. The three years 1932-34 had been definitely on the dry side for the major producing area, the Lower River districts, and as a result there was automatically a relatively early closure of the crop, giving in effect a natural close season in each of those years. 1935 saw a return to more humid conditions, and a better distribution in time of the available moisture supply prevailed. Planting was done with success over a wide range of dates while harvesting continued late. There was no close season either natural or enforced, and though that year's crop did not suffer unduly it enabled the bollworm

to breed up and provided a big carryover of pupæ into 1936. This was a very wet year and the rains continued late. Planting was again done over a wide range of dates and the moths multiplied unchecked with disastrous results, the crop being less than half that which seed issues and previous experience would have indicated as a reasonable estimate.

Attempts were made to enforce the provisions of the Pests and Diseases Ordinances (uprooting and burning of cotton bushes) in November and December, 1936, but failed to provide a close season owing to times of planting again remaining uncontrolled, and as a result the 1937 crop was no better than that of 1936.

The situation has, however, now been remedied to some extent. An energetic uprooting campaign in all areas has been followed by a minimum close season of two months, enforced for the first time in this decade by regulating the date at which seed issues commenced in the various areas. In the case of the Lower River, after some discussion seed issues were commenced at the end of December, so that planting did not start till the first week in January. Propaganda to prevent planting of non-flood areas foolishly late has been broadcast, and attempts are being made to persuade the growers not to plant the flood (or Madimba) areas later than April 30th.

When the writer produced his article on the time to plant cotton in Nyasaland (Vol XI., No. 4) the full implications of a close season as a counter measure to red bollworm in cotton cultivated by native growers had not been revealed by experience, but since the general principle of a close season has always been accepted by him, the opinions then expressed regarding the vexed topic of planting times, still hold good.

It was stated in that article that owing to a very wide range of conditions of soil and moisture supply, and a high average temperature due to its latitude and low elevation, cotton in the Lower River areas must be primarily a semi-summer or winter crop. The main pickings are in August-October in the generality of years, the largest markets being usually in September and October. The present consensus of opinion is that a close season of at least two months, preferably extending into the early rains, is necessary to control red bollworm; this means the elimination of December planting, and complete uprooting and burning of the old crop by October 31st.

Planting later than the end of February may result in failures on the non-flood lands owing to inadequate moisture supply as the dry season advances, hence the general recommendation to plant

dry-land cotton in the Lower River areas during January-February (see page 297, Vol. XI.). Owing to the time factor, not less than six months are required from sowing to uprooting; the exigencies of the close season prevent flood land planting being of use after April.

Further work on red bollworm may indicate that the planting period, now given as January-April inclusive for the types of soil and climate of the Lower River, must be further circumscribed.

The remainder of the country, other than the North Nyasa area, is primarily summer crop land, which must be sown at the break of the rains in December. It can be provided with an adequate close season only by eliminating entirely " Madimba," late sown flood or sub-irrigated lands within it, as cotton growing areas, and concentrating entirely on the summer and early semi-summer sown crops; uprooting can then take place at least one month earlier than in the Lower River areas.

Karonga in North Nyasa provides highly specialized conditions, in that the main areas of good soil are all flood land which can be sown only after the floods have subsided. Further, the rains at the north end of the Lake tend to commence somewhat later and continue longer than elsewhere, thus encouraging the elimination of all but winter crop cotton. The small summer crop areas must be ruled out, since they cannot exist side by side with winter crop cotton if a close season is to be maintained.

The classification of the Nyasaland cotton areas may now be modified as follows (see previous version, Vol. IX., p. 196):

District.	*Elevation.*	*Types of Crop.*	*Months in which*	
			Sown.	*Harvested.*
1. Lower Shire, Chikwawa } Lower River	200-500	Semi-summer	Jan.-Feb.	July-Oct.
		Winter	Mar.-Apr.	Sep.-Oct.
2. All other districts ...	1,000-2,500	Semi-summer	Jan.	July-Sep.
		Summer	Nov.-Dec.	May-Aug.
3. All other districts ...	2,500-4,000	Summer	Nov.-Dec.	May-Aug.
4. North Nyasa: Karonga Lake shore areas only	1,600	Winter	Mar.-May	Sep.-Dec.

Close seasons are provided by the above as follows:

(*a*) 1. Two months, November-December.
(*b*) 2 and 3. Two months, October-November.
(*c*) 4. Two months, January-February.

(*a*), (*b*) and (*c*) are separated from each other by considerable distances and natural obstacles, which will, it is hoped, mitigate the effect of one on another due to their close seasons not coinciding. The future will show if migration of red bollworm moths is such that it may be disregarded in this connection. Present indications are that this is so. Infestation at the Likuni Station near Lilongwe (which commenced after the Station had been in operation some four years) was presumably due to this cause, but has so far been completely controlled, in a commercial sense, by close season measures.

With planting and uprooting properly carried out in the manner suggested above, there is no reason to think that, with its present series of pests, Nyasaland will be prevented from reaching ultimately the estimated potential production of 50,000 bales of 400 lbs. of lint per annum. To do so, however, an accurate knowledge must be gained of the possibilities for harm of all the major pests, and a number of problems, not all necessarily agricultural, await solution.

The question of population is a decisive factor, and it is good to be able to refer to an extensive water-supply scheme, by the provision of wells and boreholes, carried out by Government during the past five years and still being expanded. This scheme is making habitable large areas of land suited to cotton and already included in the potential estimate for productive purposes, but hitherto lacking surface water supplies. Its effect on the future population should be considerable.

Not so good is the stimulus given by present gold mining activity to emigration on the part of adult males, and the relative lack of attractions to remain at home in Nyasaland. Only successful returns from their own exertions in their own country can remedy this, and with the present low cotton prices the outlook for a production approaching the potential estimate is not bright. On the other hand, cotton is a family crop, and not all adult males in the native population feel the urge to emigrate. It is to be feared, however, that a proportion of such stay-at-homes are the "weary Willies" of the native world, but there are still many who wish to better their lot in their own land.

Control of the pests and adequate attention to time of planting, hoeing, and uprooting propaganda should result in a return to 1935 levels of production or even higher, as soon as prices provide a sufficient inducement—approximately 6d. per lb. for American Middling in Liverpool provides a not unsatisfactory price for the Nyasaland cotton grower.

Work on the Stations has confirmed the advantages of Domira Bay as a centre for cotton work in Nyasaland. Apart from its advantages agriculturally, the geographical situation, at a point nearly central in the territory, is much in its favour.

Sub-station work has shown that the Lilongwe plateau, one of the largest compact areas of good soil in the country, offers problems peculiarly its own, and that the small Station at Likuni is well justified. This Station, some eleven miles from Lilongwe township, has each year shown increasingly promising results, and the time is now near for a commercial trial of cotton in its vicinity.

The Port Herald Station has not proved sufficiently representative of Lower River conditions, and has been augmented by a small Sub-station near Chiromo on dry land of heavier texture than that of the Port Herald " Mphala " soil.

It is felt that the country is now adequately covered by the various Stations and outside plots used for observation purposes.

Plant breeding work has produced fresh proof that while it is comparatively easy to make the initial advance in improving a seed stock—as, for example, the substitution of U4 types for the old Nyasaland Upland in Nyasaland during the period under review—further improvements tend to be slow. There is no evidence that anything approximating to a pure line of cotton is safe to use commercially under the very varied conditions of soil and climate which prevail, with the possible exception of Lilongwe, where earliness is a *sine qua non*, and all distribution has so far been confined to mixtures of high yielding U4 strains to which were added a certain amount of high yielding U4 × Cambodia crossbreds of similar lint type to U4. This distribution has so far been a leavening of the original U4 mixture sent out; which mixture still remains a most useful stock for commercial purposes, producing high yields of satisfactory quality when given the opportunity.

Most complaints during the past two years regarding commercial lint are more readily related to the after effects of insect pest attack than to seed stocks. On the other hand, several strains produced at Domira Bay have given both there and elsewhere consistently good returns, and a series of experiments combined with a large scale survey of the commercial stocks will this year enable a decision to be reached regarding the replacement of the latter by a new mixture made up of these good strains.

An extensive series of cultivation experiments, both with cotton and its rotation crops, has already given some valuable results, but these experiments—especially the rotation studies—will need to be

continued for some years yet to obtain the fullest possible information. Propaganda for the early weeding of cotton in its young stages has been carried out, since if this were attended to by growers an increase in crop of some 30 per cent. would result over that obtained with the normal native practice of delayed weeding. It has been found possible to discontinue the spacing trials in all areas except Lilongwe. In the present producing areas a standard spacing of 3 feet by 2 feet, leaving three plants per hole at thinning, is recommended.

The importance of obtaining the fullest possible information regarding the pests, and particularly red bollworm, under Nyasaland conditions, has justified the extension of the Insect Pest Control work initiated at Barberton, to this country; the Corporation having accepted Professor Munro's recommendation, made after his survey tour in 1937, to post two specialist officers of this section to Nyasaland during the coming season. In the meantime, routine records have been made on the activities of the major pests during the past five years, and the effect of the close season, enforced successfully for the first time in 1937, is being watched with much interest. It would appear at the time of writing (April, 1938) that in the Domira Bay area the larval population, all instars, of red bollworm, has been reduced to one quarter that of 1937—a most promising result.

The entomological studies are now to be extended, and should establish beyond doubt the best periods for a close season, in time and duration. They are also likely to indicate further ways in which the plant breeding work and cultivation studies in progress may be applied to the defeat of the various pests.

This brief summary of what has happened in the cotton industry of Nyasaland during the past six years may end, as did its predecessor, on a note of optimism. The country may feel proud of its success in achieving the record crop of 1935, while the chastening effects of the partial failures of 1936 and 1937 should do much to ensure that mistakes of the past are not repeated. It is considered that the record crop should be equalled, and even exceeded, in future years, but until all interests realize the problems at stake and combine in their defeat, stabilization of the country's cotton production at the level which its possibilities would suggest cannot soon be effected.

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THE KINGOLWIRA PEASANT SETTLEMENT SCHEME

[The following memorandum is reprinted with the kind permission of the Government of Tanganyika Territory. The original was submitted to the Legislative Council of the Territory as Sessional Paper No. 1 of 1938, and was prepared by the Secretariat following visits to Kingolwira by Sir Harold MacMichael and Mr. Mackenzie-Kennedy.

The Settlement Scheme described is one of several now in operation in the Territory, but is unique in that it is concerned in providing not only an outlet for surplus population in the Uluguru Mountains, but also a satisfactory means of livelihood for long-term prisoners on their discharge. The Commissioner of Prisons is working in the closest co-operation with the Department of Agriculture. The memorandum indicates the progress that has been made since Mr. A. J. Wakefield, who has recently succeeded Mr. E. Harrison as Director of Agriculture, wrote his article on Mixed Farming and Peasant Holdings in the issue of the REVIEW which appeared in April, 1934.—ED.]

THE peasant smallholding scheme at Kingolwira in the Morogoro District originated principally in the hope of ameliorating the problem of native land congestion in part of that district. It was apparent some time ago that the Waluguru, who live in the Uluguru Mountains surrounding Morogoro, would, as the tribe expanded, have to look for land in the tsetse-infested plains below the mountain range, since the area available in the hills is necessarily circumscribed. Partly with this in view and partly to provide for a large-scale demonstration of mixed farming as a preferable alternative to shifting cultivation and as a contribution to the attack on the tsetse problem, the Director of Agriculture suggested in 1933 that some sixty square miles of land at Kingolwira should be set aside. In addition to providing a corridor for natural expansion, this would also permit of extension work in connection with the cotton experiments which were then in progress on the Morogoro Experimental Farm some fourteen miles distant.

2. While it was the desire of Government to encourage the increased production of cotton by the natives of the Morogoro District it was early appreciated both by Government and by the Empire Cotton Growing Corporation, which actively co-operated with financial assistance, that the increased production of cotton must proceed without any diminution in the production of food crops. It was

decided, therefore, to utilize the Kingolwira area in order to demonstrate to the native, firstly, that the growth of cash and food crops could be complementary to one another, and secondly, that planned and orderly farming was more profitable to the farmer as well as better for the soil than the crude methods of agriculture practised by the great majority of Africans. The keeping of cattle for manure and draught purposes as well as for the supply of milk—*i.e.*, mixed farming—was to be an important part of the peasant holding system.

3. Broadly speaking, the aims of the scheme are as follows :

(*a*) To evolve a type of holding which will carry sufficient stock to enable the peasant to maintain the fertility of the soil and to reduce the manual labour required to cultivate the land.

(*b*) To introduce systematic methods of cultivation by allotting a conveniently shaped unit to permit ease of working the holding and to encourage the accumulation of permanent improvements—*e.g.*, improved housing, fruit, orchards and anti-erosion works; also, over a number of holdings, to facilitate the protection of crops from game and vermin.

(*c*) To embody a system of crop rotation both for the sake of the land and as a safeguard against the undesirable extension of a single crop; also for the provision of a more varied diet.

(*d*) To give security of tenure and to prohibit the subdivision of the holding.

The area of each holding will vary with soils and climatic conditions; at Kingolwira the size is fourteen acres. Four acres of each holding are set aside for grazing and timber for fuel and building poles. The remaining ten acres are given over to arable crops, the main rotation being sorghum, cotton, maize, and groundnuts, with subsidiaries of cassava, sweet potatoes, vegetables and fruit. The holdings are so arranged that anti-erosion measures are comprehensive with those of the whole settlement; for example, the grazing strips of the holdings run one to the other through the settlement. As more holdings are developed the tsetse fly is pushed back, and, when it is safe to do so, the peasant holders can purchase cattle from the herd maintained by the Agricultural Department.

As a first step in the scheme three selected natives were established on demonstration holdings; they received especially careful supervision and encouragement in order that their holdings and the methods followed should be well in advance of the settlement plots. This year they have been issued with a cow and two oxen (which they will pay

for at the end of the first year). These demonstration holdings are regarded as an important educative factor and have done much to popularize the settlement centre.

4. The high returns of both food and cash crops obtained by the earliest settlers resulted in applications being received from other natives for holdings at Kingolwira, and it became evident that control would have to be exercised through the medium of some form of agreement. A scheme of control has recently been evolved whereby approved applicants will be granted a probationary period of one year, after which they will be required to enter into a written agreement, a copy of which is shown in the appendix to this memorandum. This agreement has been translated into Swahili, and is, in addition, exhibited on a notice board in the centre of the estate. One of the most important features of the arrangement will be that the applicant must acknowledge the local native authority as the immediate instrument of Government, since not a few of those who have settled are aliens to the area. This, however, requires no amplification in the agreement, since it is axiomatic that a native must acknowledge the jurisdiction of the chief to whose area he migrates.

During the past two years over forty approved applicants have been given plots and the numbers are steadily increasing.

In order that the nucleus of a model settlement might be more rapidly established these natives were assisted to the extent that a portion of the heavy bush on the holding was cleared (partly by convict labour) and a temporary house was built for them. In addition, the more necessitous were provided with food until the reaping of their first harvest. It should be stated that one of the conditions laid down was that every successful applicant should lay out his plot under the supervision of an agricultural officer and first plant one acre of cassava as a safeguard against famine.

5. A further and more recent development is the settlement of long-term prisoners. This arose out of the recommendations of a committee appointed by the Governor in 1931 to consider the question of the restriction of imprisonment, the segregation of first offenders from hardened criminals, and allied matters. The committee recommended *inter alia* that long-term prisoners should receive a thorough grounding in agriculture during the period of their sentence in order that, on release, they would be in a position to lead an honest and useful life and have adequate means of support.

For reasons of financial stringency the recommendations of the committee had to be postponed for a time, but when the depression lifted it was decided to make an attempt to train suitable long-term

prisoners in agriculture by the establishment of a prison farm on Kingolwira estate.

6. A skilled brickmaker and two expert thatchers were engaged from Nyasaland and Northern Rhodesia respectively to assist in the construction of burnt brick houses to form a camp at the new settle-settlement; local natives and native authority staff were trained in brickmaking and thatching and improved housing was demonstrated. In March, 1936, the camp was gazetted as a prison and placed in charge of the Prisons Officer, Morogoro.

It is divided into two sections, the one containing short-term prisoners employed in the development of the estate, and the other the long-term prisoners who are receiving agricultural instruction with a view to receiving a plot on the estate.

7. The ground has thus been prepared for the agricultural training of long-term prisoners who, when released on licence, should be capable of working holdings by themselves if they are desirous of taking up a plot.

Two prisoners, released on licence during the past season, have in fact been settled at Kingolwira and appear to be working their holdings in a contented and satisfactory manner.

8. It will thus be seen that on Kingolwira estate there are two controlled settlement schemes, one for the absorption of the local expanding population, and the other for the settlement of long-term prisoners on their discharge from prison. The terms of settlement are identical for both. All settlers must submit to the directions of the Agricultural Department as to the development of their plots; all receive such assistance as may be necessary at the start; all undergo a probationary period of one year; and, finally, all are required to enter into an agreement when finally selected as suitable plot holders.

It is satisfactory to note that the local peasant holders do not object either to the proximity of the prison camp or to the ex-convict settlers.

The schemes are still in the experimental stage, and in the light of experience of their working modification and improvements can doubtless be made, but there are good reasons for hoping that the experiments will be successful and will increase in popularity.

9. When a sufficient number of peasant holders are settled at Kingolwira, it is intended to erect a village hall as a social gathering place as well as for the primary education of the settlers' families and instruction in carpentry and handicrafts. A model dispensary is also visualized.

10. Even in these early years, when most of the work is done by

the hand-hoe, the peasant farmers have received comparatively large sums for their surplus produce, and it is realized that one of the future problems will be to teach the native to spend wisely; with this object in view a model shop has been built and will be run in consultation with the Dar es Salaam Chamber of Commerce.

11. To anyone familiar with the difficulty of persuading the African to change his system of rotating land for one of rotating crops and of maintaining cattle in tsetse country, the importance of the Kingolwira experiment need not be emphasized. Solution of these problems will lead to decrease in soil erosion, protection of the forests from wanton destruction, and eventually (so far-reaching are the possibilities) to an improvement in domestic hygiene. It is, therefore, the duty of all those who may come into contact with the experiment, both now and in the future, to do their utmost to ensure its success.

12. Government now has under consideration the establishment at Kingolwira of an Agricultural Training School at which pupils can be instructed in improved agricultural methods on the lines of those applied to the peasant settlers. It is intended to draw these pupils from the provinces, and on completion of their training to return them to their homes for the purpose of demonstrating and instructing in model peasant farming. Those who wished to take up holdings on the settlement could, of course, be accommodated. Details of the scheme still remain to be worked out and approved.

KINGOLWIRA SETTLEMENT

Conditions of Occupation

Plot No............

....s/o..
of..................................is hereby permitted to occupy Plot No..............
in the Kingolwira Settlement so long as the Government do not require the land for other purposes and so long as the said...s/o ....observes the following conditions and remains of good behaviour.

Conditions

1. The occupier—
   (a) Will himself effectively occupy the plot and plant and maintain a sufficient area of food crops for his maintenance and that of his dependents.
   (b) Will not cultivate or graze stock beyond the limits of the said plot, unless permitted to do so by the Officer in Charge of the Settlement.
   (c) Will keep the plot free from weeds and in a good state of cultivation; furthermore, he shall, to the best of his ability, adopt such methods to counteract erosion as advised by the Agricultural Officer in Charge of the Settlement.

(*d*) Will not divide the aforesaid plot nor permit cultivation thereof by any person other than his immediate dependents.

(*e*) Will not at any time bring into the aforesaid plot any livestock other than such livestock as shall have passed through the Kingolwira Quarantine Station.

(*f*) Agrees to abide by the decision and directions of the Officer in Charge of the Settlement regarding all matters affecting the good husbandry of the plot.

(*g*) Will vacate the plot if so required by the District Officer within two months of receiving an order to vacate.

2. The said............................s/o............................may nominate the person whom he wishes to occupy the plot upon his death, and shall notify. the District Officer of the fact of such nomination, and should the said.............. s/o............................be in occupation of the plot upon his death, the person nominated may, subject to the approval of the District Officer, be permitted to occupy the plot, which shall at no time be subdivided.

3. In the event of the said............................s/o............................ being required to vacate the plot he shall be allowed to reap all crops, other than permanent crops, planted by him therein, and shall be entitled to such compensation for any permanent improvements he may have made as the District Officer may determine.

4. An order to vacate the plot shall be conveyed to the occupier in such a manner as to be effectively brought to his notice.

5. The occupier shall not be required to vacate the plot except for misbehaviour or for failure to observe these conditions, or in the event of Government requiring the land for other purposes.

6. There shall be a right of appeal to the Provincial Commissioner from any order made by the District Officer.

I CERTIFY that the above conditions have been read over and explained to the occupier, who has signified his consent thereto.

....

District Officer.

INSECTS AND FUNGI IN AGRICULTURE

BY

SIR ALBERT HOWARD, C.I.E.

Formerly Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to States in Central India and Rajputana.

Two years ago an article[1] appeared in this journal in which my general views on the relation between the host and the parasite were very briefly summarized in the following words:

"1. Insects and fungi are not the real cause of plant diseases, and only attack unsuitable varieties or crops improperly grown. Their true rôle in agriculture is that of censors for pointing out the crops which are imperfectly nourished. Disease resistance seems to be the natural reward of healthy and well-nourished protoplasm. The first step is to make the soil live by seeing that the supply of humus is maintained.

"2. The policy of protecting crops from pests by means of sprays, powders and so forth is thoroughly unscientific and radically unsound; even when successful, this procedure merely preserves material hardly worth saving. The annihilation or avoidance of a pest involves the destruction of the real problem; such methods constitute no scientific solution of the trouble but are mere evasions.

"3. The protection of an area from imported pests is fortunately almost impossible in practice on account of the rapid improvement of communications and the increasing volume of traffic. If the present regulations were really effective, they would be harmful in that we should be deprived of a portion of the censors which Nature has provided for keeping our agriculture up to the mark."

This paper, obviously written to provoke, has been followed by a number of contributions to this and other journals to which I should like briefly to reply. During the last two years a good deal of work on the influence of freshly prepared humus on disease resistance has also reached the stage when it is desirable to record some of the preliminary results and to suggest (1) a re-survey of the general agronomy of cotton, including the manuring of this crop, and (2) a re-examination of the active root system, including that of the crops grown for green manuring.

In an editorial published in October, 1936, Dr. Willis[2] drew from his long experience of tropical agriculture a good deal of

evidence in general support of my thesis, and also called attention to the difficulties which exist in coping with the diseases of established crops like tea, rubber and cacao, in which a large amount of capital has been sunk. In such cases it is, of course, impossible to scrap the crop and start again. The mycologist and entomologist must obviously do what they can to help the planter in such circumstances to keep diseases in check in the cheapest possible manner.

In the issue of this journal of January, 1937, two references occur—the first by Messrs. Bebbington and Allan,[4] the second by Dr. Harland.[5] In both, evidence is put forward that cases occur in cotton and other crops in which the healthier the plant, the more it is relished by the pest. The silkworm and the locust are also cited in these and other papers[6,7] as answers to my general thesis.

I have often observed the great damage done by insect pests to cotton and other crops which during the grand period of growth appeared remarkably healthy and well grown. I have also had some first-hand experience of the mulberry silk industry in Kashmir and have repeatedly observed the temporary damage done by locusts in India. I have spent much time in journeys through the deserts from which these invasions start and have read a good deal of literature on this subject. All this experience was in my mind when writing the paper to which exception has been taken.

Cotton and other crops belonging to the natural order *Malvaceæ* are very prone to the attacks of insect pests during the maturation of the seed. This is well seen in the case of *Hibiscus cannabinus*, and also in cotton in the Punjab, where at first the crops grow well, but where this early promise is frequently followed by a very disappointing yield—due either to failure to set seed altogether or to the inroads of insects which attack the ripening bolls. Some of the finest-looking crops of sann hemp (*Crotalaria juncea*) I ever raised for green manuring at Pusa, when grown on for seed, produced a yield far below the amount of seed sown. After flowering, the crops became literally smothered in fungous and insect pests of various kinds. A study of such cases, both on the alluvium and the black soils, revealed an interesting fact. The soil conditions, which were excellent at the time of sowing and during the early life of the crop, gradually changed as the rains proceeded, and a colloidal condition, which interfered with aeration and drainage, gradually established itself and always preceded the onset of the pests during the maturation phase. When steps were taken to prevent or to minimize this colloidal condition by the use of dressings of farmyard manure or compost, there was an immediate increase in disease

resistance and a satisfactory yield of seed. I suggest, with all respect, that Messrs. Bebbington and Allan should repeat their experiments and pay more attention to the soil conditions during the whole time the crop is in the ground, as well as to the land for some time before the actual cotton is sown.

The invasions of locusts in Central and North-West India always start from the deserts in which the eggs are laid, and produce their maximum damage on *irrigated* crops during the hot weather.* Everything green in the path of one of these swarms is either eaten or left on the ground. Soon after the rains begin and *normally grown* vegetation is available the swarms rapidly disappear. What a few weeks before was a terrifying visitation is soon reduced by Nature to its normal insignificance. The swarms peter out. I believe in no case have the locusts of the Rajputana deserts, for example, established themselves permanently in those areas of India alongside, which are fed by the monsoon. The locust in this region is a child of the desert, and has always remained so as far as Northern and Central India is concerned.

The case of the silkworm and the mulberry has no relation whatsoever to agriculture. The rearing of the worms is artificial; they do not feed on the growing leaves, but on picked foliage which is constantly changed. The developing silkworms are tended with perhaps even more solicitude than is bestowed on the majority of infants. Unless the greatest care is taken in the raising of the eggs there would soon be no silk industry at all. If a grove of well-cultivated mulberry trees were inoculated with silkworms, I am confident the amount of silk produced under natural conditions would soon bear no relation to what would be obtained when the leaves are taken to a rearing house and the insects carefully tended.

Humus and Disease Resistance

One method of ascertaining whether any relation exists between humus and disease resistance is to take a piece of land, convert all the waste products of the crops and live stock into compost, and observe the reaction of the resulting crops to insect and fungous pests. Such an experiment was started by Captain R. G. M. Wilson at the Iceni Estate, near Surfleet in Lincolnshire, in December, 1935. The results are given below in Captain Wilson's own words in a memorandum (drawn up for the members of the British Association

* Irrigated sugar cane at Indore is attacked every hot weather by moth borer. In the early rains, when the cane grows normally, this pest always disappears.

who visited the estate on September 4, 1937), from which the following extract is taken:

"The Iceni Estate consists of about 325 acres comprised as follows:

Arable land, etc.	225 acres.
Permanent grassland	30 ,,
Rough wash grazings	35 ,,
Land under intensive horticulture	35 ,,
	325 ,,

The main idea in the development of the Estate has been to prove that even to-day, in certain selected areas of England, it is a commercial proposition to take over land which has been badly farmed, and bring it back to a high state of fertility, employing a large number of persons per acre.

To this end the Estate has been developed as a complete agricultural unit with a proper proportion of live stock, arable land, grassland, and horticulture, with the belief that after a few years of proper management the Estate can become very nearly, if not entirely, a self-supporting unit, independent of outside supplies of chemical manures, etc., and feeding stuffs, the land being kept in a high state of fertility, which is quite unusual to-day, by:

(1) A proper balance of cropping.

(2) The conversion of all wheat straw into manure in the crew yards and the utilization of this manure and as much as possible of the waste products of the land for making humus for the soil.

As regards (2), the method of humus making which has been employed is known as 'The Indore Process,' and it has proved remarkably successful. The output in 1936 amounted to approximately 700 tons, and in the current year will probably be about 1,000 tons.

As a result of this utilization of humus, the land under intensive cultivation has already reached a state of independence, and for the last two years *no chemicals have been used in the gardens at all either as fertilizers or as sprays for disease and pest control.* The only wash which has been used on the fruit trees is one application each winter of lime sulphur, and it is hoped to eliminate this before long.

The farm land is not yet independent of the purchase of fertilizers, but the amount used has been steadily reduced from 106 tons used in 1932, costing £675, to 40½ tons in the current year, costing £281. Similarly the potato crop, which formerly was sprayed four or five times, is now only sprayed once, and this, it is hoped, will also be dispensed with before many years when the land has become healthy and in a proper state of fertility.

Eventually, with a properly balanced crop rotation, there is no doubt in my mind that the same degree of independence can be reached on the farm as has already been attained on my market garden land.

The probable cropping will eventually work out as follows:

75 acres potatoes.

75 acres wheat.

25 acres barley, oats, beans and linseed (for stock feeding).

15 acres roots (for stock feeding).

30 acres one year clover and ryegrass leys for feeding with pigs and poultry and cutting for hay, ploughing in the aftermath.

The live stock carried on the farm at the June returns was as follows:

22 cattle (cows and young stock of my own breeding).
14 horses (including foals).
15 sows (for breeding).
103 other pigs.
120 laying hens (of my own stock).

And although it is rather early to say, I believe that the above figures may be about right for the size of the farm, with the addition of about twenty cattle for winter yard feeding. This latter importation will be rendered unnecessary in a few years when the number of cattle of my own breeding will have increased."

Since this memorandum was written Captain Wilson informs me that the under-drainage of his vegetable garden has resulted in even better crops than those raised last year. Here is a definite case where the establishment of Nature's equilibrium between the soil, the plant, and the animal has resulted in increased crops, in higher quality produce, and in a marked improvement in disease resistance. My experience during the last forty years suggests that the growers of cotton in the strange places of the Empire would do well to take into account the lessons which this Surfleet and similar experiments have to teach us.

The Transmission of Disease Resistance from a Fertile Soil to the Plant

How does humus affect the crop generally and how does a factor like this increase resistance to disease? The large-scale trials of the Indore process now being carried out on tea, coffee, rubber, cacao and other crops in the tropics have furnished some interesting information on these questions.

In a number of cases, in tea and rubber in particular, very striking results followed closely on one dressing of compost applied at the rate of five tons to the acre. There was a marked improvement in growth and also in resistance to insect pests such as red spider, *Tortrix* and mosquito blignt (*Helopeltis*). Two applications of compost have also transformed a derelict tea garden into something above the average of the locality. In a recent tour of tea estates in India and Ceylon I have seen these results for myself, and have discussed matters on the spot with the men who have obtained them.

When these cases were first brought to my notice towards the end of 1936 and during 1937 I found considerable difficulty in understanding them. If humus acts as an indirect manure by (1) recreating the crumb structure and so improving the tilth, and (2) by furnishing the soil population with food from the use of which the soil solution eventually becomes enriched to the advantage

of the crop, such factors would take time and we should expect the results, if any, to be slow. The improvement following humus was the reverse of slow—it was immediate and spectacular. Some other factor besides soil fertility appeared, therefore, to be at work.

After much thought it occurred to me that the explanation would be found in the active root system of tea and rubber, and that the remarkable results recently obtained by Dr. M. C. Rayner[3] on mycorrhiza at Wareham in Dorset would apply to tropical crops. Accordingly, on October 7, 1937, I issued a circular letter to some of my correspondents in the tea industry in the following terms:

"*The Rôle of Mycorrhiza in Tea.*—The adoption of the Indore process on a number of tea and rubber estates in the East and on coffee plantations throughout Kenya and Tanganyika has led to some interesting and suggestive results, the significance of which I shall now endeavour to explain. The effect of compost in all these cases has not been quite uniform. In some of the tea gardens in the High Range in Travancore, which for many years have been regularly manured with farmyard manure (a form of compost), the result of Indore compost has been in the nature of a regular and steady improvement such as would naturally follow from an increase in the general fertility of the soil. On some of the tea estates in Ceylon, on rubber in the F.M.S., and coffee in East Africa, where compost has been applied for the first time, much more spectacular results have been obtained. There has been a sudden and very marked improvement in growth, in general vigour and in resistance to disease.

If humus acts only by increasing the fertility of the soil it is difficult to understand these spectacular results. There must be some other factor at work which enables the compost to influence the tea bush direct.

The simplest and most obvious explanation of the sudden improvement after one application of compost is the well-known effect of humus in stimulating the mycorrhiza which are known to occur in the absorbing roots of tea, and which in all probability are to be found in rubber, coffee and other cultivated plants in the tropics. Now compost is essential for the full activity of these mycorrhiza—a fact which has been strikingly brought out by the recent work on conifers in this country. How the compost acts is a matter which is certain to engage the attention of specialists for some time to come. I have been in touch with these investigations and have confirmed their great importance by independent observations in the nurseries of the Liverpool Corporation at Lake Vyrnwy. Compost leads to the formation of numerous mycorrhiza and to exceedingly well-grown nursery plants. Where no compost is used the growth is poor and the stock is unhealthy.

I have little doubt, when the mycorrhiza in tea roots have been thoroughly studied, that these organisms will prove to be an important factor in the general nutrition and health of the tea plant. In all probability mycorrhiza will help to broaden the scientific basis of the Indore process and will assist in explaining the failure of artificials to prolong the life of the average tea garden and to keep up the quality of tea after the original store of humus left by the forest has been exhausted."

Soon after this letter was issued I was asked by a group of the tea agencies in London to visit their estates in India and Ceylon, in the course of which some time was devoted to the study of the

mycorrhiza factor. In this I secured the co-operation of Dr. Rayner, a recognized authority in this branch of science, who has been kind enough to examine and report on no less than twenty-eight samples of roots of tea, rubber, cacao, coffee, coconuts, cardamoms, tung oil, betel palm, as well as the leguminous shade trees and green manure plants grown in the tea gardens. In all the specimens obtained from land manured with compost or from virgin forest soil, abundant mycorrhiza were observed in which all stages in the rapid digestion of the fungus by the host plant could be seen. On the other hand, in poor, derelict tea, and in tea nurseries where artificial manures had been employed, mycorrhiza were either absent altogether or very poorly developed. The connection between compost in the soil and abundant, vigorous root development with well-developed mycorrhiza and healthy growth was clearly marked.

The mycorrhiza association in tea and rubber, for example, would explain the direct action of humus on these crops. The mycorrhiza appears to be the machinery provided by Nature for the fungi living on humus in the soil to transmit direct to the active area of the roots the contents of their own cells. Whether this is the only means by which such things as accessory growth substances can safely pass from humus to plant, or whether the fungi provide essential materials for their manufacture in the plant itself, has yet to be determined with certainty. Some such explanation of what is taking place seems exceedingly probable. If the accessory growth substances contributed by humus were to pass from the soil organic matter into the pore spaces of the soil they would have to run the gauntlet of the intense oxidation processes going on in the water films which line these pores. In this passage any substance of organic origin would be almost certain to be seized upon by the soil population for food and oxidized to simple substances, such as the plant ordinarily takes in by the root hairs. If, as seems almost certain, freshly prepared humus (obtained from animal and vegetable wastes) does contain growth-promoting substances (roughly corresponding to the vitamins in food), it would be necessary to get these into the plant undamaged and with the least possible delay. The mycorrhiza association in the roots, by which a rapid and protected passage for such substances is provided, seems to be one of Nature's ways of helping the plant to resist disease.

The Separation of the Factors

A long experience of the cultivation of leguminous plants in India has completely shattered my belief in the idea that these

crops can be grown successfully without organic matter, and that the nitrogen fixation in the nodules is the complete story as far as the supply of combined nitrogen is concerned. Farmyard manure or compost, as already stated, is essential for keeping these crops healthy and for making them form seed in the Indian monsoon. Organic matter always stimulates both root and nodular development.

I was therefore naturally interested during my recent tour to see whether this is the whole story and whether or not another factor (mycorrhiza) is operating as well as the nodules. Specimens of the roots of a shade tree—a species of *Erythrina*—and of a green-manure plant (*Crotalaria anagyroides*), both of which had been manured with compost, were collected in Ceylon and sent to Dr. Rayner for examination. Mycorrhiza and nodules were found in the roots in both these cases, but never together in the same rootlets. These either bore nodules only or mycorrhiza only. These observations provide a simple scientific explanation of the common practice of manuring leguminous crops with humus in the East and in Great Britain. Humus, by establishing the mycorrhizal relationship, appears to be able to influence the plant direct. The nodules seem to supplement the mycorrhiza and are only one factor in the case.

There is a further point of some interest in this matter. When plants like French beans are grown on poor soil by means of the nodules only, or by means of artificial manures, the produce is tasteless and of poor quality. For real taste and quality in the produce it is necessary to use humus (made from both vegetable *and* animal wastes) or farmyard manure. A supply of combined nitrogen appears therefore to reach the plant by way of the nodules and root hairs; the materials which are needed for quality appear to be absorbed by the mycorrhiza. The leguminous plant therefore promises to be a very valuable instrument in separating out the various factors concerned in this question. Will, as seems to be the case, quality and disease resistance only be obtained when the mycorrhiza mechanism functions? Will disease resistance and quality turn out to be the same thing—the consequence of the perfect synthesis of proteids and carbohydrates in the green leaf? Does infection by insects and fungi most readily occur in this group when the mycorrhizal condition is absent?

One large-scale experiment I hope to arrange in Ceylon concerns the probable rôle of animal wastes in disease resistance. On a group of tea estates on this island organic matter, made from green manure and tea prunings only, is giving excellent results as far as the amount of growth is concerned. The tea, however, is

being attacked by an insect pest. I hope to be able to persuade the directors of the company to introduce pigs into the economy of one or more of these estates, and see whether or not the attacks of this insect disease can be prevented or reduced by the use of humus made from vegetable *and* animal wastes. If, as I expect, this proves to be so, additional evidence in support of the idea that live stock is essential in tropical agriculture will have been obtained.

One of the conclusions I have reached as a result of my tour in the East and of my forty years' experience of research work is that the live stock factor has been greatly neglected in the plantation industries, and that the waste products of the animal will prove to be essential in all such enterprises.

I also feel that mycorrhiza is almost certain to prove of importance to cotton, and the great differences observed in the Cambodia cotton in India, in yield as well as in the length of the fibre, when grown on (1) garden land (rich in humus) and (2) ordinary unmanured land might well be explained by this factor. At any rate, the matter should receive early attention and the results, whether positive or negative, should be duly recorded in the pages of this journal. Dr. Rayner informs me that so far mycorrhiza has not been recorded in cotton, so there is a clear field for an enterprising and well trained investigator who is not afraid to break new ground.

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NOTES ON THE INSECT PESTS OF COTTON IN NIGERIA

BY

F. D. GOLDING, M.A., F.R.E.S.

INTRODUCTION.—Between the years 1922 and 1930 the attention of the entomological section of the Agricultural Department was principally directed to the study of the numerous insect pests which attack cotton in Nigeria. The outbreak of the African migratory locust in December, 1929, diverted activities mainly to locust research, but investigations were carried out at Ibadan, Oyo and Ilugun in the Southern Provinces and at Ilorin, Bode Sadu, Yandev, and Bida in the Northern Provinces. As a result of this work and of research undertaken by members of the other specialist sections it became apparent that Allen cotton (*Gossypium hirsutum*) was unsuitable for areas to the south of latitude 9° N. for two main reasons—viz., its susceptibility to stainer attack and its unsuitability for intercropping. In the Southern Provinces Allen was replaced by an improved strain of Ishan (*G. barbadense*) bred by Lewin.[6] At Yandev, in the Benue Province, Ishan compared unfavourably with the local Munshi cotton,[5] and at Badeggi, in the Niger Province, the yield of Ishan was only about 38 per cent. of that of Allen.[2] In the Ilorin Province it was found that there was little to choose between Ishan and Ilorin cotton (*G. peruvianum*); the local variety gave a higher yield, but a greater proportion of the seed cotton was stained.

SOUTHERN PROVINCES.—As had been anticipated, the extensive infestations of stainers (*Dysdercus* spp.) ceased when the growing of Allen cotton was discontinued. Although there has been considerable variation in the abundance of stainers from year to year on the Ishan crop at Ibadan, in no season has the degree of infestation closely approached that suffered by Allen cotton in the past. In the 1935-36 season certain early-flowering hybrid cottons (Ishan×Sea Island crosses bred by Mr. Evelyn in St. Vincent[4]) in the Botanist's selection plot at Ibadan were heavily infested by *Dysdercus superstitiosus* F. Similarly, on the few occasions during the last eight years when small patches of exotic cotton have been grown at Ibadan, they have attracted stainers in large numbers.

Ishan A. has continued to exhibit a high degree of resistance to jassids (*Empoasca facialis* Jac.),[7] and to the white fly vector of leaf

curl (*Bemisia goldingi* Corb.). The hybrid cottons mentioned in the preceding paragraph were characterized by the glabrous condition of their leaves and suffered severely from jassid attack.

No estimations of bollworm damage to the Ishan crop have been made in recent years, but there has certainly been no increase in the degree of infestation since the growing of Allen cotton was discontinued in 1926. Observation of small cotton plots on native farms in the vicinity of Ibadan during the last few years has indicated that bollworm attack is less extensive on these small fields than on the comparatively large areas under cotton on Moor Plantation.

In 1931 the writer[3] expressed the opinion that the Capsid bug, *Helopeltis bergrothi* Reut., was probably the most important insect pest of cotton in the south. In some seasons a very considerable amount of damage has been done by *Helopeltis*, both on Moor Plantation and on native farms, whereas in other seasons the bugs have been almost completely absent from the crop. Counts made in the autumn of 1935 showed that 0·8 per cent. of the plants in a five-acre block of Ishan A. were severely damaged, the plants being dwarfed and unproductive as a result of injury to the main axis, whilst slight damage could be found on the majority of the plants. It is impossible to determine the loss of crop due to *Helopeltis* attack. The distribution of the bugs is sporadic and the infestation varies greatly in intensity from year to year; but there seems little doubt that in some seasons these Capsid bugs are responsible for more damage to the Ishan crop than is any other insect pest. In recent years *H. bergrothi* has been found to be an important pest of cotton in Uganda and the Belgian Congo.

During the 1924-25 season the writer[1] found that the larvæ of the Eumolpid beetle, *Syagrus calcaratus* F., were responsible for a considerable amount of damage to the roots of early-sown Allen cotton at Ibadan; although indigenous cottons were also attacked, they possessed greater powers of recuperation and their yield was not so markedly affected. During the 1937-38 season *S. calcaratus* larvæ damaged the root systems of many Ishan and hybrid plants at Ibadan, and there is little doubt that their depredations reduce the yield. Diagnosis entails uprooting, so there are no data available for cotton on native farms; plants on these farms seldom show wilt or excessive leaf-shedding, and it seems probable that *S. calcaratus* is a localized rather than a general pest.

Northern Provinces—(i.) *American Cotton* (*G. hirsutum*) *Belt to North of Kaduna.*—Although the stainer, *D. superstitiosus*, is widely spread over the Northern Provinces it is not a major pest

of the Allen crop—probably on account of the extreme atmospheric aridity which is characteristic of late October and November, when the number of green bolls on the plants is greatest. An investigation carried out by an entomological assistant near Zaria in January and February, 1938, showed that stainers were still present in small numbers on cotton grown in fadamas by native farmers. A few adults were found on the pods of okra (*Hibiscus esculentus*) and roselle (*H. sabdariffa*). Four adults and a number of first instar nymphs were discovered in old *Ceiba pentandra* pods lying on the ground. It is probable that the atmospheric humidity was higher in the small low-lying farms and inside the *Ceiba* pods than in the larger fields exposed to the full force of the arid harmattan wind.

During the same investigation, 844 cotton plants were uprooted and examined for pupæ of the spiny bollworms, *Earias* spp.; 80 live pupæ and 465 empty cocoons were found. The cocoons of these moths are very firmly attached to the plant (usually on the main stem just above ground level), so that the above figures probably give a fair indication of the degree of *Earias* infestation throughout the season. The harmattan had blown away most of the old leaves and other debris lying on the ground, and it is improbable that many of the larvæ pupated in debris on the ground. A number of the pupæ were parasitized. A few larvæ were collected from okra pods, but none were found in the fruits of wild Malvaceæ or Bombaceæ.

The same investigator made an exhaustive search of the soil in cotton fields for the pupæ of the red bollworm, *Diparopsis castanea* Hmps. One larva of that species was found in an earthen cell, and fifteen live pupæ were collected, some of which may prove to be *D. castanea*. Mr. J. K. Mayo has informed the writer that he believes *D. castanea* to be the commonest bollworm at Zaria during September.

In August and September, 1937, the cotton leaf-roller, *Sylepta derogata* F., was unusually abundant at Kafinsoli (Katsina), Bauchi and Samaru (Zaria). Time of planting experiments were in progress and *S. derogata* appeared in large numbers on the early-sown plots (planted on May 11 at Kafinsoli), and then spread to the later-sown areas. Little damage has been done by this pest in the past, and it seems highly probable that early sowing was responsible for the outbreak on account of the reduction in the length of the dead season.

Jassids are abundant in some seasons, and it has been found necessary to grow resistant strains of cotton. In one season, when

a non-resistant strain was grown on a large scale, *Empoasca facialis* was responsible for a considerable amount of damage.

Mr. Mayo considers that leaf curl is more important than stainers in the Northern belt; he has made the interesting observation that jassid-resistant strains of cotton are not invariably resistant to leaf curl. It is evident that the protective factors against Jassids and Aleurodids are not identical.

Helopeltis has not yet been recorded from the Northern belt.

(ii.) *Native Cotton : Middle Belt.*—All the important pests of the cotton-growing areas of the Southern Provinces are present in the Ilorin and Benue Provinces. Bollworm and stainer infestation is usually less extensive than in the south; but various plant bugs (principally Pentatomidæ), which are seldom found on cotton in the south, are responsible for considerable damage to green bolls in some seasons. The larvæ of the Buprestid beetle, *Sphenoptera gossypii* Cotes, were found tunnelling the roots of cotton at Bode Sadu (Ilorin Province) in 1930, and caused the death of a number of plants. It is curious that the above record is the sole evidence of the occurrence of *S. gossypii* in Nigeria, for this species is a well-known cotton pest in parts of French West Africa.

There is at present no evidence of the occurrence of the pink bollworm, *Platyedra gossypiella* Saund., in Nigeria, despite statements to the contrary which are continually appearing in papers by various writers dealing with cotton pests of the world.

In conclusion, the writer wishes to express his indebtedness to Messrs. J. K. Mayo and E. H. G. Smith for reading and criticizing the Northern and Southern sections respectively, and to the former for information incorporated in the text.

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A REPLY TO DR. MASON'S NOTE ON THE TECHNIQUE OF COTTON BREEDING

BY

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According to Dr. Mason the methods of cotton breeding in India and elsewhere are essentially similar to those used more than a decade ago. That may be so for most countries, but is by no means true for Egypt. Had he visited Egypt he would have discovered that the methods employed by the Botanical Section of the Ministry of Agriculture show very considerable advances in the last ten years.*

Up to the moment it is admitted that our most successful variety, Giza 7, which covers an area of 500,000 acres, originated in a single plant selection from a field of Ashmouni. A variety, Giza 12, however, at present on an area of 30,000 acres, which bids fair to replace Giza 7, is the result of an artificial cross between Sakel and Ashmouni. The cross was made in an effort to combine the high yield of Ashmouni with the high quality of Sakel. In this case, as we find with almost all crosses, a character turned up in the new variety which is not found in either parent. The quality of Giza 12, though higher than Ashmouni, falls considerably short of Sakel, while the yield, though as high as Ashmouni in the Delta, is produced in a different way—viz., through a very large boll—which is not a character either of Ashmouni or Sakel.

Other varieties in commercial cultivation which are the result of artificial hybridization are: Giza 26 (Sakel × Sakha 10), Giza 29 (Maarad × Sakha 3) while we have "on tap" at least another half-dozen promising new varieties. Harland's back-crossing technique also is not being lost sight of here.

For Egypt, therefore, it is *not* admitted that the bedrock of cotton improvement is still the time-honoured practice of selection in the field. On the contrary, it may surprise Dr. Mason to learn that this method is scarcely used at all now. Our single plant selections are

* A bulletin describing our methods of cotton breeding is in course of preparation and will be published in due course.

made with the aid of the Target Diagram first used by Dr. Balls, and it is a matter of amazement to the present writer that this method is not in general use. Off-types can be selected with ease from such diagrams, and it is the off-types with desirable characters that are selected for further trial and selection.

The advantages of the Target Diagram as a means of selection over selection in the field are enormous. At a glance we can select for high ginning-outturn, lint length, boll weight, etc., which it is practically impossible to do in the field. Moreover, the work involved is purely routine, and it is quite unnecessary to have a trained staff, the actual selection being made by the breeder himself.

As to the difficulty of judging the yielding capacity from a small number of plants, the eye of the breeder certainly comes in, but it does not require much seed to sow miniature chequers as we do here. Sowing alternately three rows of each of a number of trial varieties and repeating this eight times we obtain a very good idea as to the yielding capacity of each. The accuracy of these chequers does not, in fact, fall far short of that of our larger yield chequers.

The belief that homozygosity is always essential before a strain is recommended for commercial production is only too prevalent, though it was discarded here more than ten years ago. Many breeders are obsessed by this erroneous conception, which in many cases almost sterilizes their efforts. Nevertheless, even after a variety has been put into propagation, efforts are continued to purify the nucleolus seed stock by means of purity chequers and with the aid of Target Diagrams. Since there is a free flow of seed every year starting from this nucleolus, passing through a 10 feddan "nucleus" on a government farm to large cultivators and so to cultivators in general; and as samples of all seed of all varieties to be sown in the country must first be passed for purity by this Section, it will be obvious that the commercial purity of the variety is also maintained indefinitely. This seed control and renewal system I believe to be unique. The system is so effective also that there is now littl chance of improvement of a variety in Egypt by selection in th field!

In conclusion, we have frequently been assured by visitors from other cotton-growing countries that our methods of cotton breeding are many years in advance of other countries. Dr. Mason's article would appear to confirm this.

Received April, 1938.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

The first table this month gives our half-yearly revision of the statistics of the World's Cotton Crops. Since this last appeared in January the American crop has marked a further slight increase, while the total of Outside Growths, which we then estimated at little short of 21 million bales, has, as we indicated in April, dropped to about 20 million bales, but this is still larger than the previous record figure of last year. The only substantial reductions in the list are in the Indian and Chinese crops, the latter, of course, as the result of the war, but others show new records—*e.g.*, Brazil, Peru, Korea and Manchuria, Russia, Asia Minor and Egypt. This is very significant; it may mean either that the reduced world price of cotton, owing to the enormous American crop, has not yet had time to produce the expected reaction on other world crops, or it may mean that owing to the further efforts of the American Government to hold up the price of American cotton that reaction is not going to be very strong. The fact remains that in spite of the almost incredible yield of the 1937 American crop the American figure, even including linters, just manages to exceed the total of Outside Growths.

The next table gives the final details of the American crop published in May, which completes the record of the season given in the lower half of the table. It will be seen that the May figures showed slight increases all round in acreage crop and yield, contrary to the general expectation that there would be a substantial increase in acreage which would reduce the average yield.

The next table gives the details for the Egyptian crop, and it will be seen that the final estimate published in June was also a surprise, for it had been anticipated that the December crop estimate of 10,796,000 kantars excluding Scarto would be considerably reduced, whereas it was actually increased to 10,816,169 kantars, but owing to a heavy reduction of the Scarto estimate the total crop was reduced from 11,012,000 to 11,009,000 kantars.

The table of the World's Carryover of Egyptian Cotton, which follows, shows the effect of the very heavy holding movement in Egypt which was the feature of the season. The mid-season figures

at January 31 showed a monthly total nearly 700,000 kantars less than last year, in spite of the fact that the crop was estimated to yield about two million kantars more, and that the consumption for the first half of the season had shown substantially smaller figures than the second half of last season. This, of course, was due to the fact that the Alexandria figures take no account of cotton held up-country, the amount of which must at that time have been very heavy. The relative position was, however, sharply changed in March, when, owing to the heavier rate of ginning, the monthly total actually rose instead of declining, as it normally does throughout the second half of the season, and this movement was confirmed by a very small decline in April. In view of the revision of the June crop estimate, and the probable season's consumption of about nine million kantars, the carryover at the end of the season ought to show a considerable increase to say five million kantars.

We usually give at this stage of the season a table of the Indian Crop by Varieties, but every year we have to point out that these figures, which are based on the supplementary forecast of the crop published in April, are only provisional, because later the Indian Central Cotton Committee publishes a more detailed statement in which they allocate parts of the Broach and other crops to short staple and some of the C.P. Oomras crop to long staple; and we give here a summary of the allocation between long and short staple, showing first the preliminary figures which we give in July each year and the Committee's revised totals which we give in the following October:

	1934–35.		1935–36.		1936–37.		1937–38.
	April Fore-cast.	*I.C.C.C. Fig-ures.*	*April Fore-cast.*	*I.C.C.C. Fig-ures.*	*April Fore-cast.*	*I.C.C.C. Fig-ures.*	*April Fore-cast. (ex. Burma.)*
Total crop ..	4,857		5,933		6,317		5,663
$\frac{7}{8}''$ and below	3,472	3,613	3,815	4,106	3,984	4,205	3,526
Above $\frac{7}{8}''$ ..	1,386	1,244	2,118	1,827	2,333	2,102	2,137
% of total ..	28·5	25·6	35·7	30·8	36·9	33·3	37·7

This year, however, we think that it would be of interest to give in a later issue, when the figures are available, the Indian Central Cotton Committee's detailed table of the allocation for 1937-38. Meantime, it is of interest to note that the figures at present available show a slight but steady increase in the percentage of long staple.

The next table of the world's consumption of cotton according

to the Federation statistics gives the figures for the first half of the current season, and the first point to be noted is, of course, the absence, now unfortunately usual, of returns from Italy, Russia, Spain, and China. For all except Italy the Federation have inserted estimates, but for Italy they have now been able to obtain from another official source the missing figures back to season 1935-36, and it turns out that these make very little difference from the estimates we have been using.

The general result of the figures is that the decline in the consumption of American is almost entirely in the United States, while that of Outside Growths is more than accounted for by a decline of 950,000 bales of Sundries in China alone, which, of course, is again the result of the war. There is, therefore, some consolation in the fact that, apart from America and China, the world's consumption this season is holding up very well.

As to the position in America, the next table shows a slow but steady increase in their consumption, as indicated by the daily rate, from December to March, but April showed the worst figures of the season. The comparison with last year, when the U.S. consumption was running at all-time records every month, merely underlines the tremendous change which has come over the position in America.

The chief interest in the table of Highest and Lowest Futures prices which follows lies in the fact that the good recovery from the low point of October/November to February has not been maintained since then, and in May Liverpool prices again touched a new low level for the season, except for Giza 7. Perhaps the main reason for this decline was the fact that the expected recovery of business and industrial activity in America, which generally occurs in the first quarter of the year, and which was particularly desirable this year, conspicuously failed to materialize, and in the last week of March the New York Stock Exchange quotations touched new low levels in every department. The long-drawn-out fight between Washington and Wall Street still goes on, and although there are occasional hopeful signs, there is still no indication of the real revival of confidence which is essential to recovery.

By this time of year, of course, crop news begins to play a considerable part in the market. Congress has amended the acreage allotment for this year by adding to it about two million acres to allow for more generous treatment of hard cases. The weather has on the whole been favourable, but the main question is whether last year's incredible yield will prove to be only a miracle or an accident, or whether it means a permanent raising of the normal

average yield. The possibilities of this year's crop are therefore so wide that any attempt to anticipate the statistical position is largely guess-work, but the one fact underlying the whole position is the Government's long-term programme of crop loans and area restriction, which had been fairly effective till the end of May. The previous low point of the season in October was before the announcement of the new scheme.

The position with regard to spot prices of Outside Growths, as shown in the last table, is very much as we indicated in the April issue. In the case of West African and Brazilian (both Pernam and São Paulo), the actual differences or "points on" or "off" American have hardly changed at all, and the percentage changes shown in the table merely represent the decline in the basis price of American. In April East African marked a gain of ten points, while Tanguis lost exactly the same figure, and a further fifteen points in May. Spot prices of Egyptian showed a continuous decline relatively to American till May, but it must always be kept in view that Egyptian spot prices in Liverpool merely represent the position of near-month futures, which are frequently subject to manipulation. Early in May, for example, Giza near-month futures in Liverpool were very sharply depressed for a time, owing to the fear of tenders of Sakel against the contract, but by the end of the month the position was again reversed.

At the other end of the scale Indian cotton also declined very sharply in March as compared with American as a result of the heavier movement of the crop, especially the Broach crop. This produced one of those mysterious movements in the cotton market which are so puzzling to outsiders. When Indian cotton was high relatively to American, a very heavy straddle interest was opened mostly in Bombay, selling Indian and buying American in Liverpool or New York. When relative prices widened out, this straddle had to be reversed, resulting in heavy sales in Liverpool and New York, which were a considerable contributing factor in the decline of American prices in recent months. It may be mentioned in passing that another factor in that decline during May was the heavy movement of the South Brazil crop, involving hedge sales in Liverpool and New York.

WORLD'S COTTON CROPS.

(Bales of 500 Lbs.—000's.)

	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.	1937–38.
U.S.A. Lint	13,002	13,047	9,637	10,638	12,399	18,946
Linters	912	982	1,001	1,089	1,407	1,700
Total	13,914	14,029	10,638	11,727	13,806	20,646
Mexico	99	255	223	251	373	310
Brazil	438	1,014	1,359	1,765	1,712	2,282
Peru	237	278	342	380	369	396
Argentine	146	191	295	354	144	281
Other South American	39	75	71	86	131	130
India*	4,656	5,108	4,857	5,933	6,317	5,663‡
China	2,195	2,673	3,078	2,410	3,741	3,083
Japan, Korea, etc. ...	133	207	223	245	185	300
East Indies, etc. ...	13	16	15	14	16	16
Russia	1,776	1,844	1,772	2,313	3,550	3,782
Persia	79	159	200	125	161	161
Iraq, Ceylon, etc. ...	†	†	2	4	8	16
Asia Minor and Europe	68	190	246	382	344	436
Egypt	991	1,715	1,511	1,707	1,821	2,202
Sudan	110	126	237	199	266	245
East Africa (British)	269	274	273	335	349	346
South Africa (British)	2	3	3	2	3	3
West Africa (British)...	20	23	47	48	38	25
Non-British Africa ...	121	149	170	223	267	270
West Indies (British)...	2	3	4	4	4	5
West Indies (Others)...	26	24	31	25	25	25
Australia, etc.	11	18	14	14	9	20
World's Total ...	25,345	28,374	25,611	28,546	33,639	40,645
Outside Growths ...	11,431	14,345	14,973	16,819	19,833	19,999
Per cent. on Total ...	45·1	50·6	58·5	58·9	59·0	51·4

* Government estimate, 400 lb. bales. Less than 500 bales. ‡ Ex. Burma.

AMERICAN CROP (EXCLUDING LINTERS).

	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.	1937–38.
Acreage planted (000's)	36,494	40,248	27,860	27,888	30,960	34,471
Acreage harvested ...	35,891	29,383*	26,866	27,335	30,028	34,001
Crop (running bales)...	12,710	12,664	9,472	10,420	12,141	18,252
Yield per acre (lbs.) ...	173·5	212·7	171·6	186·3	197·9	266·9
Season's average spot price (Liverpool—pence per lb.) ...	5·62	6·02	6·93	6·52	7·12	——

Progress of the Season 1937–38.

	August.	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*March.*
Acreage planted ...	34,192	34,192	34,192	34,192	34,383	34,383
Acreage harvested ...	33,429	33,736	33,736	33,736	33,930	33,930
Crop (500 lb. bales) ...	15,593	16,098	17,573	18,243	18,746	18,934
Yield per acre (lbs.)...	223·3	228·5	249·3	258·8	264·6	266·7

* Less 10,396,000 acres special abandonment.

EGYPTIAN CROP.

	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.	1937–38.
Area (feddans, 000's) ..	1,094	1,804	1,732	1,669	1,716	1,978
Crop (kantars, 000's):						
Alexandria adjusted arrivals	5,050	8,438	7,540	8,375	9,125	10,990
Government figures*	4,956	8,575	7,556	8,535	9,107	11,009
Average yield (kantars per feddan)*	4·53	4·75	4·36	5·11	5·31	5·57
Season's Average Spot Prices (Liverpool—Pence per lb.).						
Sakel	7·79	8·05	8·52	9·22	10·82	—
Premium % on American	38·6	33·7	22·9	41·4	52·0	—
Uppers	7·01	6·64	7·57	7·48	8·46	—
Premium % on American	24·7	10·3	9·2	14·7	18·8	—

* Final revised figures, including Scarto.

WORLD'S CARRYOVER OF *EGYPTIAN* COTTON.

(Kantars 000's.)

End of	*Stock and Afloat.* *U.K.*	*Stock and Afloat.* *Continent.*	*U.S.A.* *Mills.*	*U.S.A.* *Warehouses.*	*Alexandria.*	*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.*
1931, January	*630*	*293*	*341*	*129*	*5,349*	*6,742*	*1,785*	*7,927*
July ..	600	165	212	108	4,452	5,541	1,418	6,959
1932, January	*1,013*	*248*	*145*	*63*	*5,521*	*6,990*	*1,447*	*8,437*
July ..	885	203	161	180	3,780	5,209	1,553	6,762
1933, January	*878*	*218*	*134*	*171*	*4,255*	*5,656*	*1,425*	*7,081*
July	742	202	131	143	2,228	3,446	1,635	5,081
1934, January	*1,507*	*337*	*142*	*106*	*3,157*	*5,249*	*1,687*	*6,936*
July ..	1,132	248	174	135	1,491	3,180	1,868	5,048
1935, January	*968*	*435*	*132*	*100*	*2,230*	*3,865*	*2,242*	*6,107*
July ..	533	285	130	110	546	1,604	1,965	3,569
1936, January	*690*	*383*	*98*	*87*	*2,368*	*3,626*	*2,078*	*5,704*
July ..	420	233	128	81	619	1,481	1,927	3,408
1937, January	*773*	*270*	*117*	*54*	*2,977*	*4,191*	*2,033*	*6,224*
February	780	315	121	73	2,784	4,073	—	—
March ..	758	255	143	65	2,112	3,333	—	—
April ..	653	240	148	75	1,686	2,802	—	—
May ..	570	187	166	70	1,253	2,246	—	—
June ..	428	135	175	75	770	1,583	—	—
July ..	353	143	160	64	515	1,235	2,062	3,297
August	248	105	146	55	351	905	—	—
September	248	165	122	56	906	1,497	—	—
October	413	270	115	58	1619	2,475	—	—
November	458	180	121	65	2,198	3,022	—	—
December	540	240	128	66	2,466	3,440	—	—
1938, January	*593*	*263*	*126*	*59*	*2,554*	*3,595*	*1,950*	*5,545*
February	555	233	133	47	2,605	3,573	—	—
March	577	225	132	42	2,740	3,716	—	—
April ..	540	203	138	41	2,689	3,611	—	—
May ..	548	248	—	—	—	—	—	—

WORLD'S CONSUMPTION OF COTTON.

(From the Statistics of the International Federation.)

(Running Bales, 000's—Excluding Linters.)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*Others.*	*Totals.*
American.	1932–33	1,400	3,836	6,004	2,655	276	14,171
	1933–34	1,461	3,976	5,553	2,238	306	13,534
	1934–35	1,049	2,782	5,241	1,997	285	11,354
	1935–36	1,378	3,038	6,220	1,793	311	12,740
	1936–37	1,262	2,506	7,768	1,458	338	13,332
1st *Half*—	1937–38	*646*	*1,236*	*3,005*	*703*	*226*	*5,816*
Indian.	1932–33	126	600	16	3,455	23	4,220
	1933–34	234	844	14	3,638	42	4,772
	1934–35	342	889	22	4,501	18	5,772
	1935–36	386	834	55	4,352	23	5,650
	1936–37	428	888	77	4,612	17	6,022
1st *Half*—	1937–38	*231*	*417*	*32*	*2,472*	*15*	*3,167*
Egyptian.	1932–33	301	442	58	104	29	934
	1933–34	366	515	69	119	39	1,108
	1934–35	362	552	55	185	41	1,195
	1935–36	356	553	45	164	60	1,178
	1936–37	390	545	52	197	89	1,273
1st *Half*—	1937–38	*183*	*257*	*22*	*89*	*65*	*616*
Sundries.	1932–33	421	1,797	32	1,922	856	5,028
	1933–34	409	2,137	33	2,154	964	5,697
	1934–35	754	3,099	19	2,456	1,152	7,480
	1935–36	613	3,189	19	2,694	1,288	7,803
	1936–37	771	3,574	41	3,245	1,464	9,095
1st *Half*—	1937–38	*369*	*1,981*	*22*	*783*	*700*	*3,855*
All kinds.	1932–33	2,248	6,675	6,110	8,136	1,184	24,353
	1933–34	2,470	7,472	5,669	8,149	1,351	25,111
	1934–35	2,507	7,322	5,337	9,139	1,496	25,801
	1935–36	2,733	7,614	6,339	9,003	1,682	27,371
	1936–37	2,851	7,513	7,938	9,512	1,908	29,722
1st *Half*—	1937–38	*1,429*	*3,891*	*3,081*	*4,047*	*1,006*	*13,454*

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(Running Bales 000's: "Foreign" in Equivalent 500-lb. Bales.)

1936-37.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
November ...	626·7	30·6	612·0	1·9	5·5	7·3	63·8
December ...	692·9	33·0	676·8	2·0	6·4	7·7	61·9
January ...	678·1	32·7	662·5	1·8	6·5	7·2	63·4
February ...	664·4	33·6	649·0	1·8	6·2	7·5	63·6
March ...	779·3	33·9	759·8	2·2	7·6	9·7	74·3
April	718·9	32·7	700·7	1·9	7·8	8·6	72·8
May	669·5	32·3	652·9	1·5	6·8	8·3	70·5
June	681·4	31·0	662·1	1·5	6·8	11·0	66·6
July	583·1	27·8	569·8	1·0	5·9	12·4	74·5
*Season's total**	7,950·1	—	7,747·9	20·1	77·9	104·2	818·9
1937-38.							
August ...	604·4	27·5	585·7	0·8	6·4	11·5	72·2
September ...	601·8	27·7	582·8	0·7	6·9	11·4	73·7
October ...	526·5	25·4	511·8	0·7	5·7	8·2	72·9
November ...	484·8	22·6	471·9	0·6	5·1	7·3	57·8
December ...	433·1	20·6	424·7	0·6	4·3	3·5	46·5
January ...	434·7	20·7	424·5	0·4	4·3	5·6	44·9
February ...	427·6	21·6	417·7	0·2	4·1	5·5	47·9
March ...	510·9	22·2	498·3	0·4	5·1	7·1	60·4
April	414·4	20·0	404·4	0·4	4·0	5·7	57·9
May							

* Revised.

HIGHEST AND LOWEST FUTURES PRICES.

1936–37.	*American.*				*Egyptian (Liverpool).*			
	New York.		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
November	11·92	11·51	6·75	6·46	10·91	9·93	7·36	7·17
December	12·54	11·85	6·89	6·54	10·24	9·80	7·77	7·31
January ...	12·85	12·24	7·15	6·73	10·15	9·83	8·05	7·61
February	12·77	12·36	7·16	6·89	10·15	9·49	8·40	7·83
March ...	*14·70*	12·79	*7·96*	7·18	*12·50*	9·89	*9·73*	8·39
April ...	14·53	12·76	7·94	7·00	12·48	10·60	9·72	8·75
May ...	13·19	12·58	7·33	6·94	11·15	10·36	9·40	8·83
June ...	12·75	11·79	7·14	6·62	9·44*	8·68*	8·48	7·91
July ...	12·58	10·75	6·92	5·93	8·84	7·90	8·42	7·46
1937-38.								
August ...	*11·07*	9·15	*6·06*	5·28	*7·96*	7·35	*7·57*	6·63
September	9·40	8·15	5·42	4·81	7·63	6·76	6·64	6·00
October ...	8·37	*7·50*	4·84	4·32	6·86	*5·89*	6·08	5·31
November	8·12	*7·50*	4·63	4·34	6·56	6·19	5·73	5·40
December	8·45	7·86	4·83	4·53	6·95	6·39	5·90	5·54
January ...	8·64	8·23	4·91	4·70	7·18	6·82	6·06	5·78
February	9·33	8·48	5·20	4·80	7·43	6·98	6·34	5·84
March ...	9·27	8·48	5·15	4·73	7·25	6·55	6·20	5·77
April ...	9·08	8·44	4·95	4·73	6·90	6·58	5·91	5·73
May ...	8·78	7·67	4·76	*4·10*	6·60	6·04	5·77	*5·04*

Maximum and minimum each season in italics.
* Quotation changed to Giza 7.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1936–37.	*American (Middling). Pence per lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil.*		*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
				Pernam (Fair).	*San Paulo (Fair).*				
November	6·72	75·0	98·8	95·1	97·3	107·7	124·1	109·8	170·4
December	7·10	75·4	98·6	94·4	96·5	107·0	125·4	110·3	146·5
January ...	7·34	73·3	98·6	94·6	96·6	106·8	130·7	111·9	139·6
February	7·41	71·0	97·6	92·8	96·2	106·3	130·0	114·3	137·8
March ...	7·95	73·2	98·7	94·3	97·5	106·9	125·8	122·1	159·5
April ...	7·22	74·2	98·6	93·8	97·2	107·6	128·4	128·1	155·1
May ...	7·36	74·3	98·6	93·9	97·3	107·5	127·9	133·0	157·1
June ...	6·95	77·3	98·6	93·5	97·1	107·2	125·9	137·8	144·6
July ...	6·12	75·5	98·0	93·1	97·2	108·7	128·3	142·2	147·9
Season's average	7·11	74·3	98·5	93·7	96·5	106·6	124·3	118·8	152·0
1937-38.									*Giza 7.*
August ...	5·63	78·2	97·3	92·0	96·4	107·1	130·2	136·4	145·3
September	5·08	75·8	97·0	91·1	98·0	107·9	133·5	132·9	151·2
October ...	4·83	77·0	95·9	90·7	99·0	108·3	142·4	129·0	160·9
November	4·64	81·5	96·8	91·4	100·0	109·7	145·3	128·2	153·7
December	4·84	78·7	96·9	91·7	100·0	109·3	141·3	128·1	153·3
January ...	4·82	77·8	96·9	91·7	100·0	109·3	141·5	125·5	153·9
February	5·21	78·1	97·1	92·3	100·0	108·6	138·4	122·6	149·3
March ...	4·97	75·7	97·0	92·0	99·0	111·1	138·2	120·7	145·7
April ...	4·80	76·7	96·9	91·7	99·0	111·5	139·6	120·2	143·5
May ...	4·46	75·8	96·6	91·0	98·9	112·3	139·2	122·4	152·0

EMPIRE COTTON CROPS FOR THE YEARS 1927–37, EXCLUDING INDIA.

(In bales of 400 lbs.)

The seasons are given as covering two years (*e.g.*, 1926–1927) because in the majority of the countries named planting takes place in one calendar year and picking in the next. In a few of these countries, however (*e.g.*, Tanganyika, Cyprus, Malta and some of the West Indian Islands), the crop is harvested in the same year as that in which it is planted. In such cases the figures should be read as relating to the crop grown and harvested in the *latter* of the two years at the head of the column.

COUNTRY.	1926–27.	1927–28.	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.	
(1) Anglo-Egyptian Sudan ..	148,118	126,115	161,536	157,769	120,310	234,964	137,384	157,625	296,131	248,285	332,687	(1)
(2) Uganda ..	131,728	138,486	204,057	129,969	191,305	203,265	294,828	285,986	253,242	321,348	338,391	(2)
(3) Kenya ..	1,232	1,241	1,984	1,518	737	1,735	4,277	6,750	8,774	16,165	22,925	(3)
(4) Tanganyika ..	15,966	32,954	27,785	23,135	11,351	18,039	30,834	39,009	58,548	67,369	60,798	(4)
(5) Nyasaland ..	2,792	4,470	6,095	9,331	4,205	5,067	5,942	10,713	21,006	13,730	13,908	(5)
(6) N. Rhodesia ..	32	17	—	—	—	—	—	—	—	—	—	(6)
(7) S. Rhodesia ..	639	90	280	1,481	1,974	579	355	689	566	329	530	(7)
(8) Union of South Africa and Swaziland	10,242	11,013	9,774	16,213	8,123	2,801	1,860	2,440	2,966	1,983	3,397	(8)
(9) Nigeria ..	27,464	20,930	32,126	43,925	18,850	6,350	24,366	28,247	58,726	60,193	46,573	(9)
(10) Gold Coast ..	285	264	296	200	297	263	68	144	146	128	145	(10)
(11) Cyprus ..	2,110	2,146	3,520	4,718	2,865	1,119	913	1,865	5,214	2,993	4,670	(11)
(12) Malta ..	342	541	379	293	201	41	34	32	20	32	32	(12)
(13) Iraq	1,800	5,200	4,700	3,300	960	409	*	—	—	—	—	(13)
(14) Ceylon ..	186	202	380	248	95	47	34	92	124	293	369	(14)
(15) Queensland ..	5,880	10,266	6.296	13,999	12,228	4,975	13,903	21,924	17,653	16,631	10,649	(15)
(16) Fiji	356	114	271	398	266	90	8	39	29	64	65	(16)
(17) West Indies ..	6,076	4,088	5,377	5,672	5,106	2,524	2,614	3,618	4,720	4,565	4,676	(17)
	355,248	358,137	464,856	412,169	378,873	482,268	517,420	559,173	727,865	754,108	839,815	
		Percentage Increase 0·8	*Percentage Increase* 29·7	*Percentage Decrease* 11·3	*Percentage Decrease* 8·0	*Percentage Increase* 27·3	*Percentage Increase* 7·3	*Percentage Increase* 8·0	*Percentage Increase* 30·2	*Percentage Increase* 3·6	*Percentage Increase* 11·3	

* *No longer included in Empire figures.*

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

415. Indian Cotton: Future Prospects. By R. G. Saraiya. (*Ind. Text. J.*, **48**, 1937, p. 46. From *Summ. of Curr. Lit.*, xviii., **4**, 1938, p. 127.) The author discusses the prospects for Indian cotton in view of the record crops reported from the U.S.A. and Egypt. After allowing for maximum activity in Indian mills, there will be a surplus of 3¼ to 3½ million bales of Indian cotton. The total prohibition of imports of raw cotton or cotton goods in India would still leave a surplus of about 3 million bales, and the prospects of marketing this at a fair price to the grower, in face of American competition, are causing concern. The author looks to Lancashire to maintain her consumption of Indian cotton.

416. Indian Cotton: Statistics. We have received from the Indian Central Cotton Committee copies of Statistical Leaflets Nos. 1-4, 1936-37, giving information regarding the following: production and other particulars in connection with long, medium, and short staple Indian cottons; stocks of Indian raw cotton held in India by the mills and the trade on August 31, 1937; receipts at mills in India of raw cotton classified according to varieties, 1936-37 season; exports by sea of Indian raw cotton classified by varieties, 1936-37 season.

417. Indian Cottons: Staple Length and Yarn Count Relationship. By N. Ahmad and V. Venkataraman. (*Ind. Text. J.*, **48**, 1937, p. 51. From *Summ. of Curr. Lit.*, xviii., **3**, 1938, p. 74.) The equation $L=0{\cdot}6+0{\cdot}009\ C$ reproduces results of laboratory spinning tests on Indian cottons of staple length (L) 0·6 to 1 inch spun to standard lea strengths (tabulated) in medium twists and counts from 6's to 40's. It has been found, however, that the laboratory results are about 15 per cent. above mill results, and therefore the equation is corrected for practical spinning to $L=0{\cdot}6+0{\cdot}0104\ C$. A calculation of staple length for a required count from this equation gives the result in hundredths of an inch (*e.g.*, 0·81 inch for 30's warp). A table is provided for the conversion of these lengths into 32nds of an inch, and a final column of figures includes a correction for the fact that the staple length as determined in the laboratory and calculated from the equation is about 0·03 inch less than the grader's estimate.

418. Indian Cotton Mill Operatives: Wages and Conditions. (*Ind. Text. J.*, **48**, 1937, p. 48. From *Summ. of Curr. Lit.*, xviii., **3**, 1938, p. 94.) Problems before the Textile Labour Inquiry Committee appointed by the Government of Bombay in 1937 are discussed in relation to the determination of a living wage standard in keeping with the Congress Government's labour programme. Particulars are given of present wage rates for different spinning and weaving processes in Bombay, of the variations in rates from city to city, and of average living conditions of Indian operatives.

419. *Herbaceum* Cottons of India. By V. R. Ayyar. (*Proc. Ass. Econ. Biol. Coimbatore* [1936], **4**, 1937, p. 80. From *Pl. Bre. Absts.*, viii., **3**, 1938, p. 215.) Evidence is given to support the belief that *G. herbaceum* is not a native of India. The present position of *herbaceum* cottons is discussed and the future outlook. It is considered that breeding with this species will have to be undertaken on a much wider basis than at present if it is to maintain its position in face of the severe competition now developing abroad.

420. Spinning Tests on Punjab-American 4F Cotton with Different Schemes of Drafts in the Speed Frames. By N. Ahmad. (*Tech. Bull. Ser. A, No.* 41, Ind. Cent. Cott. Comm., 1937.) *Summary.*—A 100-lb. sample of P.A.4F was passed through the blowroom and at the finisher scutcher was divided into five equal-sized laps, A.B.C.D. and E. which were carded separately to yield sliver of 0·15, 0·13, 0·11, 0·175 and 0·19 hanks respectively. Each sliver was given two heads of drawing with a draft of 5·93 in each drawing frame. These were then processed with fifteen different schemes of drafts in the speed frames and spun into 20's counts, and the yarns obtained were examined for strength, evenness, etc. The following conclusions are drawn:

(1) The least number of breakages in the ring frame were obtained by the normal scheme of drafts. They were found to increase as the finisher sliver became coarser, and in such cases relatively fewer breakages were obtained when the additional draft was uniformly spread out over the four frames. They were also more numerous if, consequent on the omission of a frame, the drafts in the other frames exceeded a certain value. (2) When the hank number of the sliver was decreased, the yarns were found to become somewhat less even, and the effect, as a rule, is more marked if the extra draft required is concentrated in fewer machines. The yarns spun from the lighter sliver D. (0·175 hank) with the omission of the intermediate frame are somewhat less even than those obtained from the heavy sliver C. (0·11 hank). This tendency to yield less even yarns was shown in a greater measure by the still lighter sliver E. (0·19 hank). This feature is probably due to a poorer orientation of the fibres caused by a reduction in the lateral cohesive forces arising out of the attenuation of the sliver. (3) The best strength results were given by the scheme of drafts normally employed at the laboratory. Further, the variation in yarn-strength by using different schemes of drafts in the fly frames and the ring frame was found to be quite small for the limits of drafts employed in these tests. When somewhat high drafts are necessitated, either by the use of a coarse roving or by the omission of a process, the strength is likely to fall beyond certain values of the drafts, the decrease in strength being greater when the extra draft is concentrated in the ring frame than if it is spread out in all the four machines. (4) The effect of employing different schemes of drafts in relation to yarn strength on the one hand and the output and the number of spindles on the other are discussed, and some typical cases in which, without any appreciable reduction in yarn strength, either the output can be increased or a certain amount of saving in labour, supervision, etc., can be effected, are considered in detail.

421. The Cotton and Wool Trade in Hyderabad. (*Text. Wkly.*, xxi., **526**, 1938, p. 435.) A report on the cotton and wool trade in Hyderabad, the largest Indian State, has recently been issued in connection with the Customs Department. Cotton contributes as much as 22·3 per cent. of the total customs revenue, although during the past ten years (1928-1937) the area under cotton has decreased from 4,000,000 acres to 3,000,000 acres. During the year the value of cotton exports amounted to £4,855,000, and of imports to £2,138,000. The total number of bales exported was 456,978, compared with 373,808 bales in the previous year.

422. Madras: *Cotton Cultivation*, 1936-37. (*Rpt. of Operns. of Dpt. of Agr., Madras*, 1936-37.) Co. 2, the most popular strain, which occupies more than 2 lakhs of acres in the Presidency, has the disadvantage of being late in maturing, and is therefore not quite suitable for rain-fed areas. Efforts were made to evolve earlier types by crossing with imported varieties. Steps were also taken to evolve cottons of finer and longer fibres by crossing Co. 2 with Egyptian and

Sea Island cottons. The total amount of seed of the Co. 2 strain issued during the year was 249,355 lb.

The Cotton Ginning and Pressing Factories Act continued in force throughout the year. Eight new ginning factories were erected, making a total of 625. The Cotton Transport Act, Cotton Control Act, and Cotton Markets Act also continued to function successfully during the period under review.

423. *Cotton Cultivation*, 1936-37. (*Karachi Cott. Ann.*, 1936-37, p. 17.) The area under cotton was 893,976 acres and the yield 509,340 bales, compared with 767,766 acres and 473,550 bales in the previous season. The yield of lint amounted to 227·92 lb. per acre in 1936-37, a decrease from the preceding year, when the yield amounted to 240·71 lb. per acre. A great deal of research work is being carried out with the object of obtaining long-stapled varieties of cotton resistant to jassid attack and red leaf disease even under abnormal weather conditions. Increased attention is being directed to evolving a deshi type with long staple and silky feel suited to Sind conditions, since jassids do not injure deshi cottons.

In tests carried out at the Technological Laboratory, Bombay, on the improved cottons, Sind 4F-98 showed an increase in staple length and also gave the best spinning performance. Similar tests carried out on four hybrid strains of the 4F-18 × Meade cross under study at Sakrand indicated that these strains showed much promise.

424. Karachi Cotton Annual, 1936-37. No. 4. (Pubd. Karachi Cotton Assen. Ltd. Price Rs. 2.) A useful compendium on all matters relating to the cotton trade, with particular reference to Sind, the Punjab, United Provinces, and Rajputana. Many statistical tables of crops, exports, prices, stocks, consumption, etc., are included.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

425. The following reports have recently been received:
Imperial College of Science and Technology: 30th Ann. Rpt., 1937.
British Guiana: Divisional Rpts. of Dpt. of Agr., 1936.
Ceylon: Admin. Rpt. of Actg. Dir. of Agr., 1936.
Malta: Ann. Rpt. of Dpt. of Agr., 1936-37.
Northern Rhodesia: Ann. Rpt. of Dpt. of Agr., 1937.
Queensland: Ann. Rpt. of Dpt. of Agr. and Stock, 1936-37.
,, Ann. Rpt. of Queensland Cotton Board, 1937.
Tanganyika Territory: Trade Rpt. for the year 1937.
Uganda: Ann. Rpt. of Dpt. of Agr., 1937, Pt. II.
West Indies: *Trinidad*, Rpt. of Imp. Coll. of Trop. Agr., 1937.

426. List of Agricultural Research Workers in the British Empire, 1937. (H.M. Stat. Off., 1938. Price 5s. net.) Contains the names and addresses of agricultural research workers as on June 30, 1937, and the branch of science in which each is specially interested. The volume is divided into four parts: Part A gives details of institutes and bureaux concerned with the distribution of scientific information among research workers; Part B gives the names and addresses of research workers arranged under countries; Part C classifies them according to the subjects in which they are interested; Part D is an index.

427. EUROPE. Malta: *Cotton Cultivation*, 1936-37. (*Ann. Rpt. of Dpt. of Agr.*, 1936-37.) The area under cotton was only 51 acres—15 in Malta and 36 acres in Gozo—and production amounted to 12,748 lb. of lint. There are no prospects of any near revival of cotton cultivation in these islands owing to the low prices ruling and to the extensive cultivation of cotton in other countries.

428. ASIA. BURMA: *Formation of Cotton Committee.* (*Text. Wkly,* 15/4/38, p. 506.) It is reported that the Government of Burma has formed a Committee, to be known as the Burma Cotton Committee, under the Cotton Cess Act, consisting of the Director of Agriculture as the ex-officio president, the Marketing Officer as secretary, and including six non-officials representing the various interests. The functions of the Committee will be to advise the Government on cotton policy and the necessary legislation in connection with cotton, to recommend such measures as are suitable for safeguarding and extending the existing areas under different strains of cotton, and to act as a bureau for collecting ginning and pressing returns, which were formerly dealt with by the Indian Central Cotton Committee.

429. CEYLON: *Cotton Industry,* 1936-37. (*Admin. Rpt. of Actg. Dir. of Agr.,* 1936. D. 13.) By an agreement between the Government and the Provident Investment Co. Ltd., the price of cotton was stabilized at Rs. 12 per cwt. of first-grade seed cotton delivered in Colombo. The Department of Agriculture undertook the purchase of cotton from the villagers and its delivery to the mills. A statement of account in connection with this cotton purchase scheme is given, showing a small credit balance. The largest cotton-growing district is Hambantota, while Matale district made considerable progress during the year; cotton was also reintroduced in the North-Central Province. Attempts of the Agricultural Department by demonstration and instruction during the last sixteen years to introduce a system of rotational cultivation in the dry zone with cotton as the most profitable crop, have not met with success, and cotton continues to be a chena crop. This is due partly to the fact that the peasants in the cotton-growing areas do not own lands, and they will not bring Crown land under tillage unless some permanency of tenure is offered to them. In the second place the peasant in the dry zone, in whose daily economy money plays only a very small part, cannot afford to bring a couple of acres under the plough. Unless capital is made available for investment either by private enterprise or by State action there appears to be no alternative to shifting cultivation.

430. AFRICA. MAN, LAND, AND WATER IN EAST AFRICA. By C. Gillman. (*E. Afr. Agr. Jour.,* iii., **5**, 1938, p. 329.) The present paper discusses only one of the major variables that affect East African land occupation—namely, water—which, at least for Tanganyika Territory, has been shown by the writer to have a most decisive influence on the distribution of population, and thereby on the potential use of the soil. The subject is discussed under the following headings: The Hydrologic Cycle; Precipitation; Evaporation; Run-off, Absorption and Transpiration; Water Conservation; Irrigation.

431. NIGERIA: *Marketing of Cotton.* (*Crown Colonist,* March, 1938, p. 169.) New regulations controlling the marketing and export of cotton provide for the appointment by the Governor of an advisory committee, the control of marketing by the appointment of buying areas, the issue of licences and the compulsory grading of cotton. Ginnery licences will be issued, and the place of ginning for cotton from any particular area may be specified by the Director of Agriculture.

432. NORTHERN RHODESIA: *Cotton Prospects.* (*Ann. Rpt. of Emp. Cott. Growg. Corpn.,* 1936-37.) The growing of cotton by Europeans, except for its rotation value, is unlikely, but in native areas not too remote from the railway line or on lands not strong enough for maize growing the crop would fill a much-needed want as a cash crop, and its successful establishment even on a moderate scale would be welcomed by the people and the Administration. During the past two years trial plots have been grown in the Mazabuka and Mumbwa districts

with varying success. Last season they were increased in number and the trials extended to the Luangwa Valley, where promising results were obtained. A further extension has been made this season to the lower Zambesi Valley.

An unexpectedly early visitation of one species of stainer in the Pemba area last season has shown the need for an earlier maturing cotton. Fortunately a special point has been made of earliness in the selections from the U.4 type of cotton, and a good range of quick-growing types is now available not only from Barberton, but from Southern Rhodesia and Nyasaland.

433. Northern Rhodesia: *Cotton in Plateau Regions.* (*Ann. Rpt. of Dpt. of Agr.*, 1937.) The dominant feature of the 1936-37 season on the Plateau was the exceedingly severe attack of the stainer, *Dysdercus fasciatus*, due to the very poor and late flowering of the chief host plant, *Thespesia rogersii*, and the consequent early migration of the stainer population from the trees. In Pemba most of the cotton was destroyed, and much damage was caused in other districts. Over all the areas the stainer attacks were closely comparable, and there can be little doubt that the differences in yield and degree of staining were due to the effect of soil differences on the development of the plants. This aspect of the problem, the interrelation of soil, plant, and pest, requires further investigation. The future of cotton growing on the Plateau would seem to lie in selection of suitable soils, early planting, early thorough cultivation, and the use of strains capable of producing an early flush of flowering on poor soils.

434. South Africa: *Cotton Industry*, 1936-37. (*Rev. of* 1936-37 *Cotton Crop.*) The season was characterized by good planting rains, and the crop became well established. The rainfall during the rest of the season was badly distributed, consequently yields were lower than anticipated. Hail in the Weenen district damaged a percentage of the crop, and the Orange River area was most promising until it was prematurely cut by early frosts. Bollworm and heavy stainer attacks further reduced the size of the crop in dry land areas.

Prospects for 1937-38.—Owing to the serious drought during normal planting time a smaller acreage has been planted. The condition as reported in January was very good, and a fair crop may yet be picked.

435. *Cotton Cultivation in Natal.* (*Ann. Rpt. of Emp. Cott. Growg. Corpn.*, 1936-37.) The Department of Native Affairs of the Union is showing an interest in cotton as a cash crop for natives in Natal and Zululand. A series of observation plots has been arranged for the current season, and a brief survey has been made of the vegetation of the bush of the coast belt which lies outside the zone known to carry the natural food plants of red bollworm. The result of the survey showed that in part of the area there was an almost complete absence of these natural food plants, and this fact, combined with the relatively high level of agricultural development there, makes it possible that Natal may eventually produce cotton on a considerable scale.

436. Swaziland: *Cotton Cultivation*, 1936-37. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.*, 1936-37.) The season was not favourable for cotton, largely owing to the bad distribution of a good total rainfall. In some parts of the country the first plantings were destroyed by hail; moreover, the rains in places ceased early, thus curtailing the season. On the Experiment Station at Bremersdorp the yield was only 500 lb. seed cotton per acre, owing to a combination of unfavourable weather. Conditions were better for the rotation crops, and the selection work on these was continued successfully.

In Swaziland the growing of a cash crop such as cotton has to compete with the counter-attraction of the money to be gained by natives by employment in the mines. Most natives, however, prefer to stay at home, and as improved

strains raised at the Corporation's Station find their way into general cultivation, and some improvement takes place in methods of native agriculture, cotton growing should show a development.

437. SUDAN: *Cotton Industry*, 1936-37. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.*, 1936-37.) The season was noteworthy on account of the large amount of cotton produced, the total of the Sakel crop exceeding the million kantar mark for the first time. In the Gezira results were extremely satisfactory, inasmuch as the largest area that has been cultivated since the scheme was started produced a yield of 4·46 kantars of cotton per feddan, a figure that has not been equalled for the past nine years. Blackarm disease was severe in some places, but had little effect on yield, and leaf curl was irregular in distribution and the infection was light. At Tokar the flood was better than, and the effective cotton area was three times as great as, that of the previous season, and the yield showed an improvement. In the Gash Delta also a higher output was recorded. An experimental mixed farming scheme of some 14,000 acres managed by the Kassala Cotton Company has been established, and great importance is attached by the Government to this large-scale experiment, since the development of mixed farming would have far-reaching consequences in the Gezira.

In the South, where cotton is grown under rainfall, a slight increase in yield was obtained. The Department of Agriculture emphasize the need for improved cultural methods and crop rotations in the rain areas to replace the present practice of growing cotton continuously on the same land.

For the current season, 1937-38, it is estimated that the crop will be about the same as that obtained in 1936-37.

438. TANGANYIKA TERRITORY: *Cotton Industry*, 1936-37. (*Trade Rpt.*, 1937.) The recent sequence of production records has again been maintained in spite of a 25 per cent. failure in the crop grown in the Lake Province area, caused principally by abnormally late and very heavy rains. Greatly increased production took place in the Eastern Province and other coastal areas, where climatic conditions were ideal, and Tanga has come into prominence as the Territory's second cotton port. Unfortunately, the average price realized was the lowest for several years, the market rapidly declining from 7d. per lb. in June to 4½d. in December, due mainly to the exceptionally large American crop.

439. *Native Labour Questions.* The Report of the Committee appointed " to Consider and Advise on Questions relating to the Supply and Welfare of Native Labour in Tanganyika Territory " has recently been issued. The various chapters deal with population; pastoral and food crop activities; man-power the main factor in economic development; freedom of choice; draft legislation; written and oral contracts; discipline of labourers; wages; future legislation; recruitment of labour; welfare of labour; employment of women, young persons, and children, etc. The recommendations made by the Committee under the various heads are summarized.

440. UGANDA: *Cotton Reports*, 1936-37. (*Ann. Rpt. of Dpt. of Agr.*, 1936-37. Pt. II., recently received.) From the report of the Botanical Section we learn that weather conditions generally were abnormal. At Serere, however, high yields of cotton were again obtained. N. 17 was very successful, and its performance was better than S.G. 29, despite another season of low blackarm infection. S.G. 20 maintained its high yield, but S.P. 87 failed on the scores of late maturity, non-resistance to blackarm, low yield, and unfavourable spinners' and brokers' reports. S.P. 84 proved more successful on all counts, and the consistently favourably reports from spinners and brokers are without parallel

in the history of U.4 derivatives at Serere. The strain B.P. 52 evolved at Bukalasa did remarkably well in spinning tests carried out in India and England, and it is expected that it will replace the local cotton. This strain does not appear particularly susceptible to wilt.

The Entomological Section reports that a very full investigation was carried out in connection with cotton stainers, a study being made of the bionomics, alternative host plants, and measures of control. The most practical control is that also advocated for pink bollworm—namely, the rigid enforcement of the close season for cotton growing and the curtailment of the period during which planting takes place. Powers have recently been taken by an amendment to the Cotton Ordinance giving the Director of Agriculture authority to prohibit planting after a specified date. Observations on jassid populations, though not yet complete, indicate that this pest may not be quite so important as at first imagined. It is also encouraging to find indications of varietal resistance to both jassid and *Helopeltis*.

Studies on blackarm disease were continued by the Plant Pathological Section, but most interest was again centred round the serious wilt position. If it is not found possible to eradicate wilt in Uganda it is hoped to evolve "tolerant" strains of cotton which will produce good crops in spite of the disease.

The main work of the Chemistry Section was concerned with attempts to establish intensive agricultural methods coupled with effective anti-erosion methods. The chief difficulty in inducing the peasant farmer to adopt anti-erosion methods is that he will not put in the extra work necessary on land to which he has no secure title, and little progress will result until a solution to the problem of land rights has been found.

441. *Cotton Industry*, 1937-38. (*Crown Colonist*, March, 1938, p. 166.) The buying season opened in the Eastern and Northern Provinces on January 5, prices varying from Sh. 9.50 per 100 lb. in Busoga district to Sh. 7.50 in Lango and Teso. Owing to the fall of the market later, these prices were reduced by 50 cents all round. Markets on the west side of the Nile opened on January 24, the price offered being Sh. 9 per 100 lb. seed cotton. Prices for cotton seed offered by exporters to ginners varied from Sh. 22.50 to Sh. 28.50 per ton f.o.r. railway ports and stations. Concessions in ocean freight and the wharfage dues at Kilindini harbour, amounting to some Sh. 12.50 per ton in all, will enable a fair proportion of the available seed to be shipped at present prices. At the beginning of the season it was feared that the whole exportable seed crop would be lost.

442. AUSTRALASIA: *Cotton Growing in Queensland*. (*Int. Cott. Bull.*, xvi., 62, 1938, p. 208.) Cotton growing in Queensland has had a chequered career since 1860. After extensive research work it has been proved that where cotton is grown in rotation with grass or other fodder crops, costs of production are reduced and higher yields of better quality cotton are obtained. Cotton growing and dairying form an ideal combination owing to the outlet for cottonseed-meal as a cattle feed. The spinning industry of Australia requires a short to medium staple cotton, and this demand has been met by concentrating on the production of a hard-bodied cotton having a staple length ranging from $\frac{15}{16}$ inch to $1\frac{1}{16}$ inches.

443. QUEENSLAND: *Cotton Industry*, 1936-37. (*Ann. Rpt. of Dpt. of Agr. and Stock*, 1936-37.) Adverse climatic conditions in the cotton-growing districts seriously reduced the cotton yield. The saving features of the season were the excellent yields obtained where cotton was planted on land in the first or second

season from the break-up of grassland, and the general high average grade of the cotton produced. Excellent demonstrations were also obtained of the suitability of the newer varieties evolved at the Cotton Research Station, yielding medium staple cotton of a harder character than has been produced to any extent in previous years. Not only were profitable yields obtained, but the quality of the lint was of a higher standard. Ample seed of the several strains was produced to make it possible to replace practically all the older varieties of the 1⅛-inch cottons in the coming crop. As the Australian market for this shorter and medium stapled cottons has increased—about 23,000 bales are now required to supply the spinning plants—the change-over of types of cotton grown will be highly advantageous. In contrast to the previous season, injury from pests was on the whole less severe. The most serious injury was caused by the corn earworm (*Heliothis obsoleta*), and two minor pests, the cotton looper and the cotton leaf perforator, were more troublesome than usual. The rough bollworm, jassids, aphids, and cotton stainers also caused some damage, but to a less extent than in the previous year.

In April the cost of picking was raised by the Industrial Court of Queensland, pursuant to the rise in the basic wage, by approximately 10d. per 100 lb. of seed cotton. For the coming year the Commonwealth bounty payment has been reduced by ½d. per lb. of lint, and in addition a fumigation charge amounting to 0·25 pence per lb. of lint, which was used by the Tariff Board in calculating the assistance to be granted to cotton growers, and which was added to the import parity price, has been removed by the Director-General of Health. The quantity of raw cotton on which the Commonwealth will pay bounty for the coming season has been fixed at 25,000 bales of 500 lb. lint.

444. *Cotton Industry*, 1936-37. (*Ann. Rpt. of Queensland Cotton Bd.*, 1937.) Seasonal conditions were the worst since 1932. There was a good deal of shedding of squares, and the latter part of the season was very dry. The acreage harvested was about 50,000 acres, giving a crop of 8,519 bales of 500 lb. The bulk of the cotton was classed Strict Middling or higher. Insect pest damage was slight owing largely to the dry weather. Of the varieties of cotton grown, Lone Star again headed the list with 2,366 bales, followed by Indo-Acala 1,510 bales, Cliett 1,334, Miller 1,094, and Ferguson 1,044 bales. Mebane only accounted for 308 bales, Half-and-Half for 232, and Durango for 212; 50 per cent. of the crop had a staple of 1 inch, 26 per cent. of more (to 1⅛ inches). Lint percentage for the last three years has risen from 34·007 to 34·882 per cent.

445. FIJI: *Field Notes on Cotton Growing*. By W. L. Parham. (*Agr. Jour., Fiji*, viii., 4, 1938, p. 26.) Brief notes on the subject which indicate that cotton can be a profitable minor crop. Scarcity of labour will prevent it being a plantation crop in the Colony, but there is a future for it as a smallholder's crop and as a useful rotation crop, or even in mixed cultivation. The moderate returns last season may stimulate cultivation in the next few years.

446. *Notes on Cultivation of Sea Island Cotton*. By B. Lyon Field. (*Agr. Jour. Fiji*, ix., 1, 1938, p. 18.) Instructions on planting, spacing, cultivation, thinning-out, picking, etc., for the cultivation of Sea Island cotton in Fiji.

447. WEST INDIES: *Cotton Industry*, 1936-37. (*W. Ind. Comm. Circ.*, 7/4/38, p. 127.) The area planted to Sea Island cotton was 15,005 acres, being 1,373 acres less than that estimated by the West Indian Sea Island Cotton Association for the season, and 2,619 acres more than the previous season. The increase was mainly in St. Vincent and Nevis. The total production of Sea Island amounted to 4,094 bales of 400 lb., being 400 bales more than the preceding year. The increase was mainly due to a larger crop in Montserrat. Production

of Marie Galante cotton amounted to 582 bales of 400 lb. each, a decrease of 33⅓ per cent. on the crop of the preceding season. There was a further slight advance in the average prices obtained during the year, as compared with average prices during the two previous years. Prices for the Montserrat strain ranged from 1s. 7d. to 1s. 11d., whereas for the St. Vincent strain the range was 1s. 11d. to 2s.

448. St. Vincent: *Cotton Prospects*, 1937-38. (*W. Ind. Comm. Circ.*, liii., **1029**, 1938, p. 96.) Weather conditions were very favourable for this crop, and picking of early fields began at the end of December. The quality of the lint is very good, and the percentage of stains is low. As was anticipated, the relatively dry weather favoured the breeding of the cotton worm, and second brood populations were large in many fields. The attack could be effectively controlled by dusting with Paris green at a cost of about $3.50 per acre, but growers were loth to incur this expenditure, and in one area about 120 acres of cotton were almost completely defoliated.

COTTON IN THE UNITED STATES.

449. American Cotton, 1937 Crop: Blending and Drafting. By Saco-Lowell Shops. (*Saco-Lowell Bull.*, ix., **5**, 1937, p. 28. From *J. Text. Inst.*, xxix., **3**, 1938, A 134.) Mills experiencing difficulty in maintaining the breaking strength of their yarns with cotton of the 1937 crop are advised to pay more careful attention to the blending process and to the control of the fibres during drafting. A thorough mechanical mixing and blending from an opening of not less than 20 to 25 bales, the first stage of the blending taking place in the hopper feeder of the F-7 cleaning and blending feeder, operating at a production of from 250 to 300 lb. per hour, is recommended. The advantages of the use of Saco-Lowell controlled draft drawing and controlled draft roving frames are pointed out.

450. American Cotton Mills: Spindleage Requirements. By A. W. Benoit. (*Mech. Eng.*, **60**, 1938, p. 123. From *Summ. of Curr. Lit.*, xviii., **6**, 1938, p. 188.) The article deals with the history of cotton spinning in U.S.A. from 1800 to the present day, spindleage statistics being presented in graphs. From a consideration of (1) consumption of cotton, (2) competitive fibres such as rayon, (3) increased production per spindle, (4) average counts spun, and (5) hours of operation in the mills, the author draws the conclusion that not more than 23 million spindles are required for the American industry. On January 1, 1937, 27,700,000 spindles were recorded as "in place," and 24,000,000 "active," so that there is still a large surplus. In 1925 there were 38 million "in place."

451. Hours and Wages in U.S. Cotton Textile Industry during 1937. (*Int. Cott. Bull.*, xvi., **62**, 1938, p. 274.) Dr. Murchison, President of the U.S. Cotton Textile Institute, states that active spindles at the peak of operations in 1937 averaged as high as 87 hours per week, against an average per active spindle in 1936 of 77 hours, and in 1935 of 64 hours. Cotton mill wage rates in 1937 reached the highest level in the industry's history with the exception of the war years. The average was 16 per cent. above that of 1936 and 13 per cent. above the rates prevailing during the N.R.A., according to data published by the U.S. Dept. of Labour.

452. Arizona: *Field Crops Experiments*, 1936. (*Arizona Sta. Rpt.*, 1936. From *Exp. Sta. Rec.*, 78, **1**, 1938, p. 34.) Work in connection with cotton included breeding experiments; studies of certain factors—especially soil moisture and spacing—influencing maturity and length of cotton fibres; study of grade and

staple quality of Arizona Upland and Pima cotton from representative areas; spacing experiments with Stoneville cotton; and border effect with Pima and Acala cottons.

453. ARKANSAS: *Cotton Variety Tests of* 1934-35. By L. M. Humphrey. (*Arkansas Sta. Bull.*, **344**, 1937. From *Exp. Sta. Rec.*, 78, **1**, 1938, p. 37.) In 12 cotton variety and strain tests conducted at the Cotton Substation, 10 Arkansas Acala strains, 13 Arkansas Rowden strains, Roldo Rowden 40-2-9, 3 Stoneville strains, 2 D. and P.L. strains, 2 Delfos, and Dixie Triumph 6 were consistently among the best producers.

454. *Fertilizer Experiments with Cotton in Type-of-Farming Areas.* By M. Nelson. (*Arkansas Sta. Bull.*, **346**, 1937. From *Exp. Sta. Rec.*, 78, **1**, 1938, p. 37.) With proper adjustments, fertilizers may be used with profit in all parts of Arkansas. Both nitrogen and phosphorus should be included in all fertilizer applications unless nitrogen is supplied indirectly. Side dressings with nitrogen may yield high returns in some areas, but nitrogen used alone may best be applied before planting. Side dressings with nitrogen are most effective when preceded by a moderate application of complete fertilizer.

455. TEXAS: *Irrigation Requirements of Cotton and Grain Sorghum in the Wichita Valley.* By C. H. McDowell. (*Texas Sta. Bull.*, **543**, 1937. From *Exp. Sta. Rec.*, 78, **1**, 1938, p. 36.) Experiments on Miller loam soil, 1932-36, using irrigation rates ranging from 2 to 34 acre-in., indicated that the highest average yield (lint) of cotton resulted from use of 30 acre-in. of water, which included both irrigation and rainfall during the growing season.

COTTON IN EGYPT.

456. THE GINNING OF EGYPTIAN COTTON. (*Int. Cott. Bull.*, xvi., **62**, 1938, p. 237.) In compliance with the wish expressed by the International Cotton Committee, the Egyptian Minister of Agriculture has issued a decree forming a committee composed of representatives of the Egyptian Ministries of Agriculture and Commerce and Industry and the Egyptian Cotton Ginners' Chamber to study all questions appertaining to cotton ginning, and to suggest the best measures for the improvement of this industry and for the maintenance of the good reputation of Egyptian cotton.

457. EGYPT. (*Supplement, Man. Guar. Coml.*, 1/4/38.) A very interesting number dealing with Egyptian affairs, containing the following articles in connection with cotton: "Agriculture's Many Branches" (H. E. Mourad Wahab Pasha); "Exit Giza 7 ?" (C. H. Brown); "The Cotton Congress of 1938" (Hussein Einan Bey); "Work of the Royal Agricultural Society"; "A Woman looks at Egyptian Cotton" (K. V. Tranter); "The Money Crop of Egypt."

458. WORK OF THE ROYAL AGRICULTURAL SOCIETY OF EGYPT. (*Egypt Supplement, Man. Guar. Coml.*, 1/4/38, p. 24.) The activities of the Society are widespread, ranging from technical research to practical assistance rendered to the farmer by supplying approved seeds and fertilizers, organizing agricultural and industrial exhibitions, etc., and in every way endeavouring to help the farmer to solve his problems.

459. THE MONEY CROP OF EGYPT. (*Egypt Supplement, Man. Guar. Coml.*, 1/4/38, p. 20.) Explains how cotton is financed from the producer to the exporter.

460. LE COTON, PRINCIPALE RICHESSE DE L'EGYPTE. By H. Enan Bey. (*Coton et Cult. Cotonn.*, xii., **1**, 1938, p. 17.) An interesting brief account of the

progress of cotton production in Egypt, and of the research work that is being carried out in connection with the improvement of existing varieties, the production of new types, and the control of seed purity.

461. Egyptian Cotton: Studies in Spinning and Growing, 1935-36. By H. A. Hancock. (*Bull. No.* 189, Tech. and Sci. Serv., Min. of Agr. Egypt, 1938.) In an introduction by Dr. W. L. Balls an account is given of the gradual evolution and formation of the Giza Spinning Mill. There follows a detailed account of the spinning technique employed in the spinning-test mill. The significance of results is discussed, and it is shown that cottons rank in substantially the same order at whatever counts they are spun, whether carded or combed, and whether hard or soft twisted. For test purposes a spinning 60's carded yarn 3·6 twist factor is sufficiently accurate for most purposes. The cash value of a cotton sample can be estimated from its spinning test.

The spinning value, staple measurements, and waste percentage of all the main varieties of commercial Egyptians cottons, 1934 and 1935 crops, are tabulated. There is a straight-line relationship between the spot price of raw cottons and their yarn strength at a constant count, and the grade of successive deliveries nominally the same is closely constant, but the yarn strength is found to vary widely.

A large number of commercial cottons from all over the world were tested for strength in comparison with Egyptian cottons, and results showed that nearly all other cottons are weaker, and have a much higher waste percentage than Egyptian cottons.

A report on the yarn strength of Egyptian mixings covers the whole range of Egyptian cottons, mixed in varying proportions and with few or many components to the mixings. It is shown that the yarn strength of any 50: 50 mixing is near to the average strength of the components; if the components are present in other proportion, the mixing strength is found to be weighted according to that proportion.

In an experiment to test whether the roller-gin can damage the staple and adversely affect the spinning value of cotton, a standard gin was run at high speeds and maladjusted in every way imaginable, but it was not found possible to damage the staple or to weaken the yarn.

In an experiment in varying the feed of cotton to the carding engine, the lap weight per unit length was varied, but the gearing was so adjusted that a constant weight of cotton was always fed per minute. The comparison was thus between slow thick laps and fast thin laps, and the essential variant was the thickness of the cotton fringe presented to the taker-in. Rather surprisingly the fast thin laps were found to produce much stronger yarns, a fact which may have useful industrial application. Approximately parallel-haired laps produced by rolling up the sheet of cotton falling from the gin-roller were also compared, but were found to give inferior results to normal laps.

Experiments were carried out to test the effect of jute on the spinning value of cotton. Various amounts of jute were deliberately added to cotton, but even when the quantities were greatly in excess of that normally present the effect in spinning or on the yarn strength was found to be trivial.

462. Exit Giza 7? Propagating New Varieties of Cotton. By C. H. Brown. (*Egypt Supplement, Man. Guar. Coml.*, 1/4/38, p. 15.) Giza 7 was the first of the Giza selections of the Botanical Section of the Ministry of Agriculture to be a large-scale commercial success. It has now, however, been beaten in yield per acre by Giza 12 and in quality by Giza 29, and recent crossing between Giza 7 and Giza 12 has evolved a still higher yielding strain.

463. A Study of Some Aspects of the Fruiting of Cotton. By M. A. Fikry. (*Bull. No.* 34, Roy. Agr. Soc. Egypt, 1938.) A study carried out in 1937 at the Society's farm at Bahtim on the distribution of flowers and bolls throughout the season, and on the relation between flowers and bolls. The importance is stressed of the months of June and July to the fruiting of the cotton plant, since the greater production of flowers and bolls during the early part of these two months the greater the prospect of a better yield. Of the six varieties studied—Ashmuni, Bahtim Abiad, Maarad, Giza 7, 12 and 28—the best results were obtained with Ashmuni, Bahtim Abiad, and Giza 12, which give a large crop of flowers at a time when the majority can set into bolls with a good chance of maturing and producing a good crop. Several tables of statistics and diagrams are included in the bulletin.

COTTON IN OTHER FOREIGN COUNTRIES.

464. Argentina: *Cotton Industry*, 1936-38. (*Int. Cott. Bull.*, xvi., 62, 1938, p. 199.) The crop of 1936-37 amounted to 142,000 bales, compared with 367,000 bales in 1935-36, this deplorable result being due to the continued drought. Fears were expressed for the prospects of the 1937-38 crop, but fortunately heavy rains saved the situation, and conditions returned to normal after an anxious period. An increased acreage was planted by farmers, and much enthusiasm was displayed even in districts where little cotton had previously been grown.

465. *Boletin Mensual* (*Bull. No.* 33, Min. de Agr. Buenos Aires, 1938) contains various articles in Spanish dealing with "The Production of Cotton in Argentina in 1936-37 by Provinces"; "Comparison between the Universal Standards for Cotton and the Official Standards of Grade of the Argentine Republic"; "The Cotton Industry in England." Various statistical tables are included dealing with acreage, production, consumption, prices and exports. An attempt is made at predicting production in 1946-47 from present tendencies, and the countries are placed in the order: Brazil, United States, China, Russia, India, etc.

466. *La Produccion de Algodon en la Republica Argentina y en Otros Paises.* (*Bull. No.* 26, Min. de Agr., Buenos Aires, 1938.) A second and improved edition of this publication, which contains many useful diagrams and tables of statistics.

467. *El Algodon Argentino en el Campo, Las Fabricas y Los Transportes.* (*Bull. No.* 25, Min. de Agr., Buenos Aires, 1938.) A book of illustrations of all the operations involved in the production of cotton.

468. The Belgian Cotton Industry. (*Int. Cott. Bull.*, xvi., 62, 1938, p. 270.) The greater part of the mills use American cotton, but over one-third of the raw material is Indian. The quantity of yarn produced is about 70,000 tons a year. Imports of yarn are comparatively unimportant, about 5,000 tons, generally finer qualities, coming from England. About one-third of the cloth produced is absorbed at home. Imports of finished cotton goods amount to about 4,500 tons a year, a considerable part coming from Britain.

469. Belgian Congo: *Cotton Industry.* (*Int. Cott. Bull.*, xvi., 62, 1938, p. 214.) Production of lint cotton in 1936 totalled 30,600 metric tons, compared with 25,828 tons in 1935. These figures include the cotton produced in the mandated territory of Ruanda-Urundi. The estimated production for 1937 is 33,000 tons of lint cotton. There are nine ginning companies operating 119 ginneries in the Colonies, and the total investment in the industry is said to amount to some 150,000,000 francs.

470. *Quelques Particularités de l'Activité Cotonnière au Congo Belge.* By A. Landeghem. (*Bull. Trimestr. du Com. Cotonn. Congolais,* iii., **8,** 1938, p. 1.) A brief account of cotton cultivation in the Belgian Congo, and indicating the collaboration that exists between the Government and the cotton-growing companies. By decree of August 1, 1921, the companies are under no obligation to make main roads, give prizes, or superintend cotton cultivation; they have to establish the ginneries and buying-stations, and the minor roads necessary. Agricultural implements have been extensively distributed (8 million francs' worth in 1936-37) and 875,000 francs have been voted annually for three years for the establishment of experiment stations. A manual of cultivation has been prepared and distributed.

471. THE EXPANSION OF COTTON GROWING IN CENTRAL AFRICA. By A. de Bauw. (Paper read at the XVIIIth International Cotton Congress, Cairo, 1938.) An interesting account, with special reference to the "Free Market System," now proving inadequate in the British Colonies, and the "Zoning System" successfully used in the Belgian Congo, which is gradually replacing it.

472. BRAZIL: *Cotton Prospects,* 1937-38. By R. E. Brennan. (*Int. Cot. Bull.,* xvi., **62,** 1938, p. 200.) In São Paulo cotton crop conditions are generally good. Reports from the interior state that insect damage is not much in evidence, and since farmers are now accustomed to the use of arsenate of lead for the control of leaf worm and other cotton pests, there is no cause at present for worry on this account. In North Brazil it is estimated that the crop will be around 186,000,000 kilos, and grades are said to be good.

473. BULGARIAN COTTON INDUSTRY REORGANIZATION. By F. Magri. (*Bollettino Cotoniera,* **32,** 1937, p. 591. From *J. Text. Inst.,* xxix., **2,** 1938, A. 124.) The industrial evolution of Bulgaria from 1878-1935 is discussed. A textile industry has grown up large enough to satisfy the national consumption, and the State has had to intervene by regulating activity. There is a trend towards nationalization, and the State has adopted a strongly protective policy. New industrial legislation is discussed.

474. CHINA: *Cotton Industry,* 1937-38. (*Int. Cott. Bull.,* xvi., **62,** 1938, p. 203.) The Chinese Cotton Statistics Association estimates the Chinese cotton acreage at 11,243,000 acres, and the production at 3,083,000 bales, compared with 3,741,493 bales in 1936-37. The decrease is partially due to excessive rains and floods in the Shangtung and Hopei provinces, and also to neglect of the crop due to political unsettlement.

475. *Some Cotton Problems in China.* By Y. J. Chen. (*Proc. Ass. Econ. Biol. Coimbatore* [1936], **4,** 1937, p. 78. From *Pl. Bre. Absts.,* viii., **3,** 1938, p. 215.) The earlier cotton breeding work in China is briefly reviewed, the chief feature being the acclimatization of American cottons. An important problem to-day is the breeding of drought-resistant varieties.

476. *Reconstruction of Tsingtao Mills.* (*Text. Wkly.,* 8/4/38, p. 470.) The Association of Japanese Cotton Spinners in China has acceded to the request of the Commerce Office that the work of reconstruction of the cotton mills in Tsingtao should be proceeded with gradually. It is proposed to instal 355,000 spindles, 32,000 throwing machines, and 7,000 looms. Where possible idle spindles will be transferred from Japan, but some members of the Association are not happy about this in view of the alleged technical difficulties connected therewith.

477. COTTON GROWING IN ETHIOPIA. (*Int. Cott. Bull.,* xvi., **62,** 1938, p. 210.) The question of the supply of raw materials for the Italian textile industries from

Italian colonies seems to have made further progress towards its settlement through the creation of the Compagnia del Cotone d'Etiopia and of the Ente del Cotone Africa Orientale. The latter is to have a capital of 25 million lire, 50 per cent. of which is to be subscribed by the Istituto Cotoniero Italiano. Italian East Africa is to have its cotton districts. Four of them have already been established at Tessenei, on the River Auasc, at Metemma, and at Cobbo, while a fifth one might be established on the Giuba. The Compagnia del Cotone has already started the cotton plantations in three districts. According to the project of the company, everything connected with a rational cotton output in the various districts is to be built, starting from warehouses, ginning and baling plants, to subsidiary plants such as oil mills to obtain cotton oil, soap factories, etc. The company is to be in charge of the propaganda for cotton growing among natives, and of the supervision of plantations, etc. The growers, who are to obtain concessions for plantations in the districts where the Compagnia del Cotone is developing its activity, will be compelled to sell the whole of their cotton output to the company itself in order to avoid dangerous fluctuations of prices. The Compagnia del Cotone d'Etiopia has just increased its capital to 14 million lire in order to meet the requirements of the first operations to start plantations.

478. Association Cotonnière Coloniale. *Bull. No.* 29, 1938, contains the following among other articles: " Le développement de la culture cotonnière en Afrique Equatoriale Française " (W. J. Lugard); an account of the progress made in the industry from 1929-30, when 500 tons were exported and 900,000 fr. were paid to the natives, to 1936-37, when 8,000 tons were exported and 18,000,000 fr. were paid to the natives; " Les nouvelles variétés de coton d'Egypte en filature "; " L'anatomie florale comme moyen de classification des cotonniers " (P. Abraham and V. R. Ayyar); " Les progres de la production du coton dans les colonies portugaises " (de Mello Geraldes). The usual notes on cotton in the French Colonies and other countries, marketing, etc., are included.

479. La Question Cotonnière en Afrique du Nord. By C. Munck. (*Coton et Cult. Cotonn.*, xii., 1, 1938, p. 1.) A discussion of the possibility of cotton cultivation in North Africa, where it would be of much value. Experience has shown that it is possible in Morocco, Algeria and Tunis, but as yet little expansion has taken place. Details are given of the regulations in each colony under which cotton cultivation will be allowed.

480. Textile Fibres: Production in French West Africa. By J. P. Sisley. (*Rev. Gen. Matières Colorantes*, 42, 1938, p. 2. From *Summ. of Curr. Lit.*, xviii., 5, 1938, p. 129.) An illustrated account of the production and improvement in French West Africa of cotton, sisal, kapok, wool, Guinea hemp (" dah "), guama, ramie, piassava, raffia, coconut, oil palm, etc.

481. Paraguay: *Cotton Industry.* (*Int. Cott. Bull.*, xvi., 62, 1938, p. 205.) The Government have announced that they intend to abolish the exchange appropriation in respect of cotton, and this will naturally be of great assistance to the whole industry. The sale of seed, which hitherto has been a Government monopoly, is now to be free. The acreage planted to cotton for the 1937-38 season is estimated to be 10 per cent. larger than that for the previous season.

482. Russia: *Deliveries of Soviet Cotton.* (*Text. Wkly.*, xxi., 526, 1938, p. 435.) A recent issue of *Pravda* states that the collective and State farms of the U.S.S.R. have completed their cotton deliveries to the State. By March 1 some 2,514,623 tons of raw cotton had been delivered to the authorities. This represents 100·1 per cent. of plan, and 121,679 tons more than was delivered to the State from the cotton crop of 1936. By March 1 more than 1,000,000,000 roubles had been

paid out to the cotton growers in the form of bonuses for deliveries in excess of quota. The Soviet enterprises will this year be supplied with 50,000,000 poods (one pood=36 lb.) of cotton fibre, 2,000,000 poods of which will be fibre from Egyptian cotton.

SOILS AND MANURES.

483. Mother Earth. Being Letters on Soil addressed to Prof. R. G. Stapledon, C.B.E., M.A. By G. W. Robinson. (Thos. Murby and Co., London, 1937. Price 5s. 6d. From *Bull. of Imp. Inst.*, xxxvi, **1**, 1938, p. 131.) In this book an attempt is made to present the fundamentals of our scientific knowledge of the soil in a form which will appeal to those not versed in the more technical aspects of pedology. The treatment throughout is from an agricultural standpoint, indicating the bearing of the purely scientific side of the subject on agriculture, both at the present time and in the future. The work is not intended as a textbook covering the whole of the ground in detail, and is written in an informal style as a series of letters. Soil structure, moisture, and fertility are discussed in the first half, while the second is concerned with different types of agricultural soils and soil surveys, and concludes with a consideration of waste lands, erosion, and soil conservation.

484. Essays in Applied Pedology. II. Some Factors in Soil Mechanics. By G. Milne. (*E. Afr. Agr. Jour.*, iii., **5**, 1938, p. 350.) After explaining the terms texture, consistence, structure and tilth of soils, the author discusses the texture and consistence of tropical soils, the nature of clay, the part played by humus, and structure under different vegetation types. He recommends more attention to the study of liming in East Africa, and to humus manufacture, with a view to preserving soil structure.

[*Cf.* Abstr. **84**, Vol. XV., of this Review.]

485. The Destruction of Organic Matter in the Preliminary Treatment of Soils for Mechanical Analysis. By A. N. Puri and A. Sarup. (*Soil Sci.*, 44, **1**, 1937, p. 87. From *Exp. Sta. Rec.*, 78, **1**, 1938, p. 5.) The authors compared three methods in a series of experiments carried out at the Irrigation Research Institute, Lahore, India. The nine soils used were all selected for high humus content in order to subject the oxidation methods to a severe test. From the data presented it is concluded that " the potassium permanganate method is the most efficacious in the destruction of organic matter; next comes oxidation with sodium hypobromite. Hydrogen peroxide treatment is the least effective."

486. Movement of Moisture in Soil. By M. R. Lewis. (*Oreg. State Hort. Soc. Ann. Rpt.* 28, 1936. From *Exp. Sta. Rec.*, 78, **3**, 1938, p. 301.) The author, an irrigation engineer of the Oregon Experiment Station and the U.S.D.A. Bureau of Agricultural Engineering, considers the relationship of the plant to soil and soil water as " one of dynamics—that is, moving bodies and changing forces. Water is continually moving from the moist soil to and into the roots and through the plant to the leaves, where it is evaporated." He finds that " water will not move by capillary action more than a few inches at a rate fast enough to be of any importance to tree or nut growth; second, that infiltration into the soil may sometimes be very slow and may be very different in different parts of the same grove. Both of these findings mean that the grower needs to study moisture conditions in his soil. A great deal can be learned by the use of a soil auger or a shovel and simple examination of the soil. More can be done by systematic sampling and moisture determination."

487. Soil Drainage and Utilization of Vleis. By R. H. Roberts. (*Rhod. Agr. J.*, March, 1938, p. 195.) The causes of water-logging in Southern Rhodesia are discussed, and various types of drains—open drains, French drains, tile drains, mole draining—are described. The growing of such moisture-loving grasses as swamp couch grass, Hunyani grass, Rhodes grass and paspalum (*dilatatum*) is suggested. The general practice of burning rank grass on a vlei is deprecated, since the burning of the natural covering of grass exposes the soil to the direct heat of the sun, thus opening up cracks and desiccating the soil.

488. Conservation of the Soil. By A. F. Gustafson. (McGraw-Hill Pubg. Co. Ltd., London, 1937. Price 18s. From *Bull. of Imp. Inst.*, xxxvi., 1, 1938, p. 129.) The term "soil conservation," taken in its wider sense, would include all agricultural practices which maintain the fertility and tilth of the soil. In countries where soil erosion is an ever-present menace the importance of its control looms large, and it is with this aspect of soil conservation that the present book is chiefly concerned.

The problem of soil erosion as it occurs in the United States is reviewed on the broadest lines, the thorough treatment and numerous illustrations making the book of particular interest to those wishing to study the subject as a whole. At the same time, in describing the various control methods, the author has included a wealth of practical detail which will be of value to farmers and land-owners. In addition to the various forms of erosion by water (sheet erosion, gullying, and landslides), the effects of erosion by wind and by waves are discussed, with suggestions for their control. Water erosion naturally receives the fullest treatment, and chapters are included on contour tillage, strip cropping, terracing, soil protection by meadows and forests, and the control of gullies by dams and the use of vegetation. The book concludes with two interesting chapters on special aspects of the subject, one dealing with the control of erosion on public highways, and the other with the control of floods.

489. The Importance of Soil Conservation. By W. C. Lester-Smith. (*Trop. Agr. Ceylon*, February, 1938, p. 84.) The text of an address given at Balangoda, Ceylon, dealing with the causes of soil erosion and preventive measures.

490. Erosion and Soil Conservation. By G. V. Jacks and R. O. White. (*Tech. Commn.*, No. 36, Imp. Bur. of Soil Sci., Harpenden, England, 1938. Price 5s; $1.25 in Canada and U.S.A.) The paper describes the present position with regard to erosion in the most seriously affected countries, the causes that have brought erosion into being, and the measures that are being taken or are contemplated to eliminate the causes and mitigate their effects. The countries dealt with include those of the Mediterranean region, Russia, India, Ceylon, East Indies, China, Japan, French Overseas Possessions, South Africa, Rhodesia, East Africa, West Africa, United States, Canada, West Indies, Australia, and Fiji.

491. Fiji: *Soil Erosion.* By H. W. Jack. (*Agr. Jour. Fiji*, 8, 4, 1937, p. 4.) The question of soil erosion is of paramount importance to a country in the agricultural stage of development reached by Fiji. The marked difference between contour cultivation in the dry zone and its virtual absence in the wet is well brought out. The pernicious practice of shifting cultivation and its attendant evils is stressed, and it is incumbent that steps be taken against it in Fiji while there is yet time.

492. Soil Erosion Investigation by the North Carolina Station. By F. O. Bartel. (*N. Car. Sta. Rpt.*, 1934. From *Exp. Sta. Rec.*, 78, 2, 1938, p. 260.) A summary of engineering experiments in soil erosion control, including

terracing and its cost, design of farm machinery for operation on terraced land, use of check dams, etc.

493. Soil Fertility, Nutrition, and Health. By Sir Albert Howard. (Reprinted from *Chemistry and Industry*, vol. lvi., 52, 1937, p. 1155.) A clearly expressed and interesting account of the results obtained by the Indore compost process, which in various local modifications is now spreading rapidly and coming into use in Britain as well as in a great part of the rest of the world.

494. Compost on a Mixed Farm in Kenya. By J. E. A. Wolryche-Whitmore. (*E. Afr. Agr. Jour.*, iii., 4, 1938, p. 279.) An interesting account of compost-making on a farm at Rongai, Kenya Colony. Composting was commenced some four years ago on the Indore system, but has been altered to suit local circumstances. Two farms of about 2,700 acres are worked as one, and have 1,100 acres under main crops and some 250 under a weed fallow; 300 tons of compost were made in the first year, and during the last twelve months over 1,200 tons have been produced; it is hoped to work up to 2,000 tons. The cost of the compost, exclusive of added phosphates, is under Sh. 1/50 per ton, and it is considered a very profitable investment.

495. Compost. By S. D. Timson. (*Rhod. Agr. Jour.*, April, 1938, p. 279.) Describes a modified method for composting maize and wheat wastes in Southern Rhodesia. The great obstacle is the cost of transport of the material. The establishment of cattle kraals at the shelling dumps and threshing sites and the preparation therein of the compost is recommended.

496. Effect of Fertilizers on Some Nitrogenous and Other Constituents of the Cotton Plant as Separated by Electrodialysis at Different Stages of Growth. By E. R. Collins and N. E. Rigler. (*Soil Sci.*, 44, 3, 1937, p. 217. From *Exp. Sta. Rec.*, 78, 3, 1938, p. 329.) The roots and tops of cotton plants grown in Texas with and without fertilizers on Wilson clay loam near Elgin, and Houston black clay near Greenville, were analysed periodically during the season by electrodialysis for nitrogen fractions, inorganic phosphate, and calcium. The nitrogen fractions of the cotton plant reflected soil conditions and seasonal variations better than the total nitrogen. Ammonia nitrogen was relatively low in the plants throughout the growing period; amide nitrogen was also low during the earlier stages, but increased as the season advanced. Trends for total cathode nitrogen and for basic nitrogen, its principal constituent, were similar. The slight decline in early plant development was more noticeable in the tops, but the subsequent pronounced increase was more rapid in roots. The tops contained less amide nitrogen but more basic nitrogen and more phosphate than the roots. The nitrate content decreased from a relatively high concentration early in the season to a relatively low one during boll formation, and was subsequently maintained. The total anode nitrogen followed closely the trends of nitrate nitrogen. Plants on soils treated with high nitrogen fertilizers contained a greater concentration of all nitrogen fractions than those on untreated soils. The phosphoric acid concentration generally was in proportion to that in the fertilizer used. The concentration of calcium in the tops increased with plant maturity. The plant's calcium content was not affected materially by fertilizers on the soils. Methods developed for preparation of samples of cotton plant material, and procedures by electrodialysis technique adaptable to plant biochemical studies, are given in detail. This method of separation of the nitrogen fractions largely eliminated interfering substances. A study of the rate of electrodialysis indicated that practically all of the ions are removed within twenty-three hours.

497. Machine Placement of Fertilizer for Cotton. By H. P. Smith *et al.* (*Texas Sta. Bull.*, 548, 1937. From *Exp. Sta. Rec.*, 78, 3, 1938, p. 407.) Reports investigations carried out from 1932 to 1935 in co-operation with the U.S.D.A. Bureau of Agricultural Engineering, the National Fertilizer Association, and the Joint Committee on Fertilizer Application. Experiments were made at Bryan, Temple, College Station, and Nacogdoches, Texas. The best germination of cotton seed and the highest yields were obtained when the fertilizer was placed to the sides and below the seed level, but if the fertilizer was placed within 1 inch of the seed germination was injured. The results of applying fertilizer in both wide and narrow bands directly under the seed indicated that the 3-inch depth gave the highest number of seedlings for both width bands, but the 2-inch depth gave the highest yield for the narrow bands and the 1-inch depth for the wide bands. For 250, 500, and 750 lb. rates, the 500 lb. rate applied in bands 2½ inches to each side and 2 inches below the seed level gave the largest number of plants, but the 750 lb. rate applied 3½ inches to each side and 2 inches below the seed level gave the highest yield.

498. The Effects of Potash Fertilizer on Cotton in Louisiana. By J. Y. Oakes. (*La. Sta. Bull.*, 291, 1937. From *Exp. Sta. Rec.*, 78, 3, 1938, p. 329.) Fertilizer experiments, 1930-34, under field conditions on several soil types showed that certain Coastal Prairie soils and the lighter Coastal Plains soils of Louisiana are low in available potash. The lighter soil types appeared low in nitrogen, phosphorus, and potassium, and the best results were obtained from potash when used in a balanced mixture. The Crowley soils seemed low in phosphorus and available potassium, and also to respond to completely balanced fertilizer. Control of cotton rust and wilt through use of potash fertilizers seemed in most cases to be correlated with or coincident to stimulation of vegetative growth and increased yields of seed cotton. Potash starvation causes premature shedding of leaves, prevents proper development of bolls, which may fail to open, makes cotton hard to pick, and often results in lint of inferior quality.

499. Potash Deficiency Symptoms. By O. Eckstein, A. Bruno, and J. W. Turrentine, with the collaboration of G. A. Cowrie and G. N. Hoffer. (Thos. Murby and Co., London, 1937. Price 8s. From *Bull. of Imp. Inst.*, xxxvi., 1, 1938, p. 131.) The three principal authors are in charge of the scientific work of the national potash organizations in Germany, France, and the United States respectively, and the authoritative nature of the book could hardly be greater. The first part deals with general symptoms of potash deficiency, including its effects on the external appearance of the leaf, root, blossom, and fruit, and on the inner structure of the plant; the influence of a lack of potash on resistance to diseases, pests, and climatic factors; the relation between potash deficiency and the market value of crops; and the pathology of potash deficiency. In the second part potash deficiency symptoms on various cultivated crops are considered, Dr. Hoffer contributing a section on maize and other cereals and Mr. Cowrie one on fruit trees. There is also a short section on vines. A striking feature of this second part is the coloured illustrations, which in fifty-four plates depict the changes which are undergone in the appearance of forty-five different crops owing to lack of potash in the soil. The subjects covered range from cereals, pasture crops, vegetables and fruit trees, to tropical crops such as cotton, sugar-cane, coffee, tobacco, etc. There are, in addition, forty-one half-tone illustrations. Each section of the book and the descriptions of the illustrations are printed in German, French and English, so that the actual amount of reading matter is not great. Nevertheless it forms a very comprehensive summary of the present knowledge of the subject, as will be seen by the fact that the references in the bibliography number over 200.

CULTIVATION, IRRIGATION, GINNING, ETC.

500. SOME EXAMPLES OF STATISTICAL METHODS OF RESEARCH IN AGRICULTURAL AND APPLIED BIOLOGY. By M. S. Bartlett. (*Suppl. J. Roy. Statist. Soc.*, **4**, 1937, p. 137. From *Pl. Bre. Absts.*, viii., **3**, 1938, p. 207.) The author illustrates the use of statistical technique by means of a number of interesting examples drawn from experimental work, mainly agricultural. The points dealt with include partial confounding in experimental design, the use of covariance, sampling (a section which contains an important test for the homogeneity of a set of estimated variances), and the efficient detection of treatment effects. A new method of calculating a missing value is described.

501. COTTON SEED: EFFECT OF BACTERIORHIZAL MICRO-ORGANISMS ON GERMINATION. By A. A. Isakova. (*C. R. Acad. Sci.*, U.R.S.S., **13**, 1936, p. 429. From *Summ. of Curr. Lit.*, xviii., **4**, 1938, p. 119.) The author has examined the stimulating effect of suspensions of bacteria from soils and plants on the germination of cotton seed, wheat, buckwheat, legumes and mustard. There appears to be a specific hormone-like action; cotton seed was stimulated most by the bacteriorhiza from a soil mixture, but nearly as well by a cotton plant suspension.

502. COTTON SEED: VERNALIZATION. By N. Konstantinov. (*C. R. Acad. Sci.*, U.R.S.S., ii., 1936, p. 299. From *Summ. of Curr. Lit.*, xviii., **4**, 1938, p. 95.) Treatment of seed to accelerate development failed with *Gossypium herbaceum, arboreum, hirsutum, barbadense, peruvianum, brasiliense, Palmerii, mexicanum, punctatum, Davidsonii,* and *lanceæforme*. In one trial the seed was stored in dishes for eighteen days at 25-30° C., but it was found difficult to maintain constant humidity. In another trial the seed was buried in muslin bags in a large heap of damp Upland cotton seed for thirteen days at 25° C.

503. LA COSECHA MECHANICA DEL ALGODON. By G. Mata and R. A. Franchelli. (*Bull. No.* 27, Min. de Agr. Buenos Aires, 1938.) A discussion of experiments in mechanical cotton picking, with special reference to the Rust cotton picker. It is stated that the labour difficulty may become acute when the present area under cotton is increased by 50 per cent., and that the advent of a good mechanical cotton picker is to be desired in Argentina.

504. CENTRIFUGAL COTTON GIN. (*Text. Rec.*, March, 1938, p. 51.) This new American centrifugal cotton gin is the invention of Mr. F. H. Watson, Jonesboro, Arkansas. It is constructed as follows: The ginning element, which replaces the saws in the conventional gin, is an endless belt covered with hooked teeth similar to the standard gin tooth. This belt is approximately 11 feet long and is carried by three rollers or pulleys. It may be driven at a rate of 3,500 to 5,000 feet per minute. The straight run of the belt, which is the front or ginning side, is about 5 feet and inclined to about 25° from the perpendicular. The roll box is about 3 feet in diameter, as compared with about 12 inches diameter in the standard gin. The bottom portion of the roll box is flat or horizontal, and constitutes a seed screen. Its construction is similar to a gin saw cylinder, having a series of steel discs. These revolve toward the belt The seed cotton is fed to the belt at its lower end and the hooked teeth on the belt carry seed cotton into the roll box and on to the top of the belt, where it is discharged by centrifugal force; that is, the seed or partially ginned seed is thrown away from the belt at that point, while the lint, which has been engaged by the teeth, is carried around the top pulley, and down to the third pulley, where it is doffed in the usual way —brush or air blast. The seed or partially ginned seed moves upward from the point of discharge and follows the curved crown of the roll box. This crown

is screened and a suction of air is provided, which draws trash, motes, and other foreign matter through the screen. The partially ginned mass follows the screen and falls by gravity to the portion of the seed screen furthermost from the gin belt; the seed screen, acting as live rollers, conveys the material back in contact with the toothed belt, where the operation is repeated. Seed falls through the seed screen when sufficiently cleaned, and is conveyed to the end of gin stand. It is estimated by the inventor that seed and cotton moving upward with the belt at a speed of 4,000 feet per minute have a pull of approximately 2 lb. per seed, and therefore leave the lint, which is engaged by the teeth. This is three times the resistance required to separate the lint from the seed. This powerful centrifugal action also separates the foreign matter from the lint, the extra large size of roll box providing escapement for all foreign matter through the screen. The gin, it is claimed, will gin cotton which has been submerged in water. Every seed and every fibre is discharged from the gin immediately after the feeding ceases, preventing the mixing of seed or fibre from one bale to another. The gin handles the shortest cotton up to 2½-inch staple, and no adjustment is necessary at any time. Being fed at the lower end of the belt, no object that would damage the teeth can be carried into the gin.

505. COTTON GIN FEED MECHANISM. By M. Pilette. (*Bull. Trimestr. Comité Cotonnier Congolais*, **8**, 1938, p. 18. From *Summ. of Curr. Lit.*, xviii., **6**, 1938, p. 157.) The feeding mechanism of gins is discussed, starting with the first American machine with horizontal feeder. A list of more modern gins is given and a gin of the standard type made by the Continental Gin Co., with combined feeder and cleaner, is described, with section drawings.

506. BRUSH AND AIR-BLAST SAW GINS: COMPARISON. By M. Pilette. (*Bull. Trimestr. Comité Cotonnier Congolais*, **5**, 1937, p. 33. From *J. Text. Inst.*, xxviii., **8**, 1937, A418.) The working parts of various brush and air-blast saw gins are shown in diagrams and discussed, and recent experiments by Bennett with the Murray gin are summarized.

507. SAW GIN RIBS: SETTING AND MAINTENANCE. By M. Pilette. (*Bull. Trimestr. Comité Cotonnier Congolais*, **7**, 1937, p. 81. From *J. Text. Inst.*, xxix., **2**, 1938, A64.) A discussion of the ribs used in saw gins of the single rib and double rib Huller types, and of the setting, care and repair of these ribs.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

508. RECENT ADVANCES IN ENTOMOLOGY. By A. D. Imms. (J. and A. Churchill Ltd., London, 1937. Price 15s. From *Rev. App. Ent.*, xxvi., Ser. A, **1**, 1938, p. 47.) This is a revised edition of a book first published in 1931. The general arrangement is unchanged, but certain chapters are modified and supplemented with new data. Subjects of interest to economic entomologists, on which the information has been revised, rewritten or extended, include insect responses to light, fatal low temperatures, humidity, climate in relation to distribution, symbiotic micro-organisms, biological races, locust phases, and the control of noxious weeds by insects. A new section on the influence of air currents on dispersal of insects is added.

[*Cf.* Abstr. **267**, Vol. VIII., 1931, of this Review.]

509. A GLOSSARY OF ENTOMOLOGY. By J. R. de la Torre-Bueno. (Brooklyn Ent. Soc., Brooklyn, New York, 1937. Price $5.00. From *Rev. App. Ent.*, xxvi., Ser. A, **1**, 1938, p. 11.) This glossary is based on "An Explanation of Terms used in Entomology," by J. B. Smith (1906), which has been completely revised and rewritten. The terms included are those used in all branches of

zoology where insects may be considered, some used in chemistry, physics, botany and medicine, and a very few used in mathematics. With most of the older terms that have been anglicized, the Latin form is also shown, and many other Latin forms are given. The arbitrary signs and symbols used in entomology and a list of Latin abbreviations are included in appendices, and a final series of plates show the names of the chief anatomical structures in insects, with particular reference to Rhynchota and Lepidoptera.

510. Les Plantes à Roténone. Leur Intérêt à Madagascar comme Insecticide. By C. Frappa. (*Bull. Econ. Madagascar*, N.S., No. 9, 1937. From *Rev. App. Ent.*, xxvi., Ser. A, **1**, 1938, p. 67.) A survey from the literature of the chemistry and insecticidal properties of rotenone, and the distribution and characteristics of the plants from which it can be obtained, with special mention of those that occur in Madagascar.

511. Les Insectes Parasites du Cotonnier dans la Région de Lisala. By P. Henrard. (*Bull. Agr. du Congo Belge*, xxviii., **4**, 1937, p. 609.) A long list is given of insects belonging to twenty-one families which injure cotton in the district, and measures of control are suggested. The major pests mentioned include jassid, *Helopeltis*, pink bollworm, *Earias* spp., stainers, locusts, aphids, etc.

512. Nyasaland: Cotton Pests in 1936. By C. Smee. (*Rpt. of Dpt. of Agr.*, 1936.) More serious injury to cotton was caused by stainers than for some years past, and it is thought possible that there may be some connection between it and the relative humidity, which was about 10 per cent. higher than in the three preceding years. Of 400 bolls picked at random from various situations in the Lower River districts, 11 per cent. were damaged by bollworm and 42 per cent. by stainers. It is suggested that bollworm could be controlled by the enforcement of a dead season of two months between the destruction of old crops and the planting of new ones, but this might be difficult to regulate owing to the multiplicity of planting dates where normal and river-flood lands are in juxtaposition. In areas where red bollworm is prevalent the dead season should include a portion of the first rains, since most of the moths emerge during the first showers and there are very few wild plants on which they oviposit. Kidney-cotton plants are severely infested, and should be eradicated in all new cotton-growing areas. Other pests attacking cotton included leaf-roller (*Sylepta derogata*), *Cosmophila erosa*, and *Acontia grœllsii*, the last being parasitized by a Braconid, *Disophrys* sp. The Lamiid beetle, *Tragischoschema wahlbergi*, attacked the tops of cotton plants, and stem-boring by its larvæ was severe in the vicinity of Sterculia trees or Dombeya plants, which appear to be the alternative hosts.

513. Tanganyika: Cotton Pests in 1936. By W. V. Harris. (*Ann. Rpt. of Dpt. of Agr.*, 1936.) The chief pests encountered were pink bollworm, stainers, Callidea bug, and Helopeltis bug. Increased injury was caused by the last-named, and it must now be regarded as a major pest. In the east a species of *Chelonus* parasitized 7 per cent. of pink bollworm, this being the highest recorded parasitism of this species by a Braconid in Tanganyika. Towards the end of the season *Pediculoides ventricosus* was found for the first time on larvæ in bolls that had already opened. Of 45 larvæ isolated in the laboratory only 17 gave rise to moths, the remainder dying as a result of *Pediculoides* attack. *Dysdercus orientalis* var. *pulchra*, Schout, is recorded for the first time as injurious to cotton in the territory. *Callidea bohemani* Stal. is prevalent in the eastern zone, *C. dregei* Gerst. is found in the western zone; both species have been demonstrated as vectors of internal boll disease, the latter being the most injurious at present. Helopeltis bug was present in increasing numbers in areas of the

eastern zone, where cotton is grown at the foot of mountain masses—that is, the Usambara, Pare, Handeni, and Morogoro districts—and in some instances the injury resulted in complete loss of the crop.

514. Boll Weevil Control. Compiled by C. F. Clark. (*Miss. Sta. Bull.* 319, 1937. From *Exp. Sta. Rec.*, 78, 3, 1938, p. 373.) The results of a series of experiments on bollweevil control, conducted in Oklahoma in several localities and each year on different fields, by the U.S. Dept. of Agriculture, Bureau of Entomology, and the Oklahoma Experiment Station, are reported upon for the years 1928-33, details being given in table form.

515. Status of the Pink Bollworm in Puerto Rico during 1935-36. By L. C. Fife. (*J. Agric. Univ. Puerto Rico*, xxi., 2, 1937, p. 233. From *Rev. App. Ent.*, xxvi., Ser. A, 1, 1938, p. 42.) Partly owing to the damage caused by pink bollworm, the production of Sea Island cotton in Puerto Rico has been largely discontinued, the area planted decreasing from 20,000 acres in 1931 to 100 acres in 1934. In 1934-35, however, preparatory to the redevelopment of commercial cotton-growing, much of the wild cotton, the most important alternative food plant of pink bollworm, was eradicated on the island. In 1935-36 about 2,000 acres of cotton were planted. Pink bollworm occurred throughout the commercial cotton-growing region along the north coast, and in parts of the south and south-west coasts. Wild cotton on the east and south-east coasts was also infested; this infestation was probably due to moths brought by air currents from adjacent islands on the east. Pink bollworm was not found on cotton in the interior, but there the commercial and wild cotton plants are rare. In 1935 infestation occurred late in the season, and in December boll infestation per field averaged 30·2 per cent. and ranged from 3 to 95 per cent. In 1936 infestation was unusually heavy; on the north coast boll infestation per field averaged 24·3 per cent. and ranged up to 100 per cent. according to locality. At least 30 per cent. of the cotton crop was destroyed. The probable reasons for such serious injury included the use of infested seed, a too short close season, and inadequate clearing of the fields after harvest. During the close season a few larvæ fed on the seed capsules of *Montezuma speciosissima* and *Thespesia populnea*. In the south infestation was low in 1936, averaging 12·9 per cent. The climate of Puerto Rico favours the development of pink bollworm throughout the year.

516. The Introduction and Colonization in Puerto Rico of Beneficial Insects Parasitic on the Pink Bollworm of Cotton. By K. A. Bartlett. (*Puerto Rico Sta. Agr. Notes*, 77, 1937. From *Coton et Cult. Cotonn.*, xii., 1, 1938, p. 37.) A study of three imported parasites—*Chelonus blackburni*, *Exeristes roborator*, and *Microbracon kirkpatricki*—and of an indigenous parasite, *Perisierola* sp.

517. Damage to Sea Island Cotton by the West Indian Blister Mite (*Eriophyes gossypii*, Banks) in Puerto Rico. By L. C. Fife. (*J. Agr. Univ. Puerto Rico*, xxi., 2, 1937, p. 169. From *Rev. App. Ent.*, xxvi., Ser. A, 1, 1938, p. 41.) This is a major pest of cotton in Puerto Rico, and has also caused serious injury in India, the West Indies, and Florida. The most noticeable injuries to heavily infested plants are crumpled leaves, distorted growth, and lack of fruiting branches. Small leaves develop later along the main stem where fruiting branches usually form. There appeared to be no abnormal shedding of the squares or young bolls. Observations in Puerto Rico indicate that there is no hibernation period; mites continue to develop throughout the year on green cotton that has not been destroyed. A thorough cleaning of the old fields and a strict enforcement of a close season when no green cotton is present would probably give control.

518. Note sur Deux Nouvelles Chenilles Nuisibles au Cotonnier à Madagascar. By C. Frappa. (*Bull. Econ.*, Madagascar, N.S. No. 7, 1936. From *Rev. App. Ent.*, xxvi., Ser. A, **1**, 1938, p. 67.) In 1934 larvæ of the Noctuids, *Cosmophila flava* F. and *Acontia* (*Xanthodes*) *grœllsi*, Feisth., were found feeding on the leaves of cotton in Madagascar. Females of *C. flava* oviposit preferably on the lower, but also on the upper side of the leaves of Malvaceæ, including cotton, and the larvæ prefer large leaves for feeding. The larval and pupal stages last 24-25 and 5-6 days respectively. Observations on the bionomics of *A. grœllsi* in the Transvaal are summarized.

519. The Constitution of Nectar secreted by the Extra-Floral Glands of Cotton, a Natural Food of the Bollworm Moth, *Heliothis armigera* Hubn. By F. S. Parsons. (*Proc. Roy. Ent. Soc.*, London, xii., **10-12**, 1937.) The relation of food requirements and feeding habits of the cotton bollworm moth, *Heliothis armigera*, to mating, longevity and fecundity have recently been examined. Food and sex responses have a special interest in studies of the perception, by olfactory or other means, of the food-plant.

According to various investigators, and supported by the author's own investigations, the moth requires carbohydrates and can convert to monosaccharides the sucrose which is fed commonly in varying solutions to insectary material. In nature, however, *H. armigera* imbibes freely the sugary secretions of the nectaries of cotton and other plants, the constitution of which, it appears, is not known specifically, and the analysis herewith presented was undertaken primarily with a view to composing a natural food. The analysis of the nectar shows:

Reducing sugars, glucose and fructose (mannose present in minute quantity)	32·00 per cent.
Sucrose	1·36 „ „
Water	66·00 „ „
Potassium and sodium as chlorides and probably some acid potassium oxalate	Trace.

520. Preference of Corn Earworm Moths for Sweet Corn for Oviposition. By G. W. Barber. (*J. Econ. Ent.*, xxx., **5**, 1937, p. 802. From *Rev. App. Ent.*, xxvi., Ser. A, **3**, 1938, p. 144.) Observations in Virginia in 1925-27 established the fact that sweet maize received many more eggs of *Heliothis obsoleta* than field maize. Eggs were laid on sweet maize and field maize at the average rates of 1·5 and 0·4 per plant per day respectively. While the abundance of eggs varied with the year and season, the preference for sweet maize was always observed, though it was greater in June and July than in August and September.

521. The Maize Trap Crop for the Control of Corn Earworm in Cotton. By W. J. S. Sloan. (*Queensland Agr. J.*, January, 1938, p. 76.) A maize trap crop—4 per cent. of the rows—was established, and the maize sown three and six weeks after the cotton. When it came into tassel it was treated with a solution of 1 lb. lead arsenate, 1 gallon molasses and 1 gallon water, in an endeavour to destroy larval populations of the corn earworm bred on the maize. The results of the experiment proved satisfactory, and the cost was small.

522. Uma Nova Especie de *Gasterocercodes* Pierce, Broca do Algodoeiro no Brasil (Col. Curcul.). By E. J. Hambleton. (*Rev. Ent.*, vii., **4**, p. 345, Rio de Janeiro, 1937. From *Rev. App. Ent.*, xxvi., Ser. A, **2**, 1938, p. 115.) The species of *Gasterocercodes* that bores in the roots of cotton in Brazil is here described as *G. brasiliensis*, sp.n.; it had previously been misidentified as *G. gossypii*, Pierce, the only known species of the genus.

[*Cf.* Abstrs. **492**, Vol. VIII., **134**, **135**, Vol. XV., of this Review.]

523. LE SHEDDING. By A. Brixhe. (*Bull. Trimestr. du Com. Cotonn. Congolais*, iii., 8, 1938, p. 4.) The causes of shedding are briefly discussed. Parasitic shedding is due to attacks of jassid or other parasitic organisms. Physiological shedding may be caused by excess or lack of moisture, lack of soil fertility, over-exposure to sun, insufficiency of internal nitrogen, and sudden climatic changes. To avoid abnormal shedding it is suggested that exaggerated spacings and late sowings should be abandoned, in order that the greatest number of bolls can be obtained per hectare rather than per plant.

524. JASSIDS ON COTTON IN MADRAS. By M. C. Cherian and M. S. Kylasam. (*Madras Agr. J.*, February, 1938, p. 76.) Two species of jassid are found on Cambodia, Uppam and Karunganni cottons, *Empoasca devastens*, Dist., and *E. formosana*, Paoli. The former is more abundant, and is recognizable by a pair of black dots, one on each side of the apical end of the tegmen; the latter can be distinguished by the faint brown patches on the wings and the absence of black dots. Both nymphs and adults feed on the under side of the leaves. The curling down of the margins of the leaves, development of red lesions along the upper margins, and cream-coloured patches on the under side are the chief symptoms of jassid infestation. Eggs are laid in the petioles, twigs and succulent leaves, the egg period varying from 5 to 15 days. Nymphal period occupies about 10 to 12 days. There are five instars, all the stages being passed on the under side of the leaves. Both sexes are present in the field in almost equal numbers; they are known to live up to 23 days. Contact sprays with nicotine gave good results against adults and nymphs, especially the latter.

525. PHASE TRANSFORMATION IN LOCUSTS IN THE FIELD. By J. S. Kennedy. (*Nature*, **140**, No. 3551, 1937, p. 889. From *Rev. App. Ent.*, xxvi. Ser., A, **1**, 1938, p. 6.) In the winter of 1936-37 investigations were carried out in the outbreak centres of *Schistocerca gregaria*, Forsk., on the Red Sea coast of the Sudan, to elucidate the process by which phase *solitaria* is transformed into phase *gregaria* in the field. For various reasons, including visual attraction, hoppers in the fourth and fifth instars tend to concentrate in patches of dense but uneven vegetation, such as unweeded millet cultivation. Here the sun's radiation produces a close patchwork of different temperatures, humidities and light intensities, and small patches of bare ground constitute the warmest and driest situations. The reactions of solitary hoppers to the temperature stimulus cause them to form loose basking groups on these bare patches. Such crowding together may have the same effect as breeding in densely populated cages, and phase transformation would probably be impossible without the bare patches, however numerous the locusts became. Hoppers of phase *gregaria* were too active to remain together on the bare patches, so that bands tended to break up in unweeded cultivation. Such vegetation is therefore indispensable for the production of the phase *gregaria*, but the continued existence of the latter is only possible if the bands or swarms break out of it.

526. THE LOCUST OUTBREAK IN AFRICA AND WESTERN ASIA IN 1936. By P. B. Uvarov and W. Milnthorpe. (*Econ. Adv. Coun. Comm. Locust Contr.*, H.M. Sta. Off., 1937. Price 3s. From *Rev. App. Ent.*, xxvi., Ser. A, **1**, 1938, p. 111.) In continuation of the similar survey for 1935 the breeding and migrations in 1936 of *Schistocerca gregaria*, Forsk., *Locusta migratoria migratorioides*, and *Nomadacris septemfasciata* are discussed in detail and illustrated by a series of maps. The appendices contain a note on the occurrence in 1936 of *Patanga succincta*, L., and *Locusta migratoria manilensis*, Meyen, in North Borneo, and a bibliography of papers dealing with locusts and grasshoppers, published in 1936, continuing and supplementing those in the previous surveys.

[*Cf.* Abstr. **121**, Vol. XIV., of this Review.]

527. SUR LA PRÉSENCE DU *Bacillus prodigiosus* CHEZ LE CRIQUET PÉLERIN (*Schistocerca gregaria* FORSK.) By P. Lepesme. (*Bull. Soc. Hist. Nat. Afr. N.*, xxviii., **6**, 1937, p. 406. From *Rev. App. Mycol.*, xvii., **3**, 1938, p. 173.) *Bacillus prodigiosus* was isolated on peptonized meat bouillon and on agar from the blood of adult desert locusts (*S. gregaria*) which succumbed to an epidemic developing at the Central Laboratory of Locust Biology, Natural History Museum, Algiers, at the end of December, 1936, and persisting throughout the following January. Shortly after death the bodies of the diseased insects assumed a characteristic reddish tinge, especially on the abdomen. In the writer's experiments, *B. prodigiosus*, just isolated from sick or dead locusts, killed individuals of *S. gregaria* in 12 hours by inoculation and in 24 by ingestion, whereas after repeated subculturing the former method only was effective and death was delayed for 3 days. It was not possible to recover *B. prodigiosus* from the alimentary canal of the infected locusts, only from the blood. The presence of the pathogen in the eggs, however, was clearly demonstrated by the red colour of their interior.

528. MEMORIA DE LA COMISION CENTRAL DE INVESTIGACIONES SOBRE LA LANGOSTA CORRESPONDIENTE AL ANO 1935. (*Min. Agr.*, Buenos Ayres, Argentina, 1937. From *Rev. App. Ent.*, xxvi., Ser. A, **3**, 1938, p. 146.) This is the third report on investigations on *Schistocerca paranensis*, Burm., conducted under the auspices of the Central Commission of Locust Investigations in Argentina. An account is given by P. Kohler of studies on the pigments and on the biology of *S. paranensis* carried out at San Jose, Salta Province. The dispersion and southward spring migration of swarms of *S. paranensis*, which hibernate in Northern Argentina, and the northward return of their progeny are described by J. B. Daguerre, and illustrated by maps. It is suggested that Dipterous parasites and fungous diseases are the chief factors inducing the migratory behaviour. Successful breeding in the north is prevented by infestation by *Sarcophasa caridei*, Brethes, as well as by excessive heat. It is concluded that there are no phases in this species, in which existence in a solitary state is transitory and accidental. Solitary adults were found between October and December, 1935, but they concentrated into swarms at the approach of migrations. With these solitary adults of *S. paranensis*, however, there also occurred adults and hoppers of a truly solitary species, probably *S. cancellata*, Serv. Both kinds of solitary adults are described.

The different types of hydrophilous forest vegetation of the Chaco region are dealt with by T. Meyer. *S. paranensis* prefers tall open forest and xerophilous forests and thickets, but only the riverine meadows overgrown by tall *Panicum prionitis* are completely free from it. Dispersed locusts live mainly in savannahs on high ground among espartillo grass; they do not, however, touch the grass, but feed on tender Compositæ and Leguminosæ. An account of laboratory investigations on locust biology since 1935 is given by J. Liebermann. Preliminary experiments showed that a humidity of 50 to 70 per cent. and a temperature of 25-30° C. were necessary for normal development. Some eggs were infected by the Phycomycete *Cunninghamella* sp., which caused their desiccation; experiments on artificial infection of eggs with this fungus were successful.

[*Cf.* Abstrs. **597**, Vol. XII., and **497**, Vol. XIV., of this Review.]

529. FACTORS AFFECTING THE ATTACKS OF SUCKING INSECTS OF COTTON. By A. M. Gwynn. (*E. Afr. Agr. Jour.*, iii., **4**, 1938, p. 314.) The principal sucking pests discussed are stainers, *Lygus*, *Helopeltis*, aphid, and jassid, and the following conclusion is presented: "The question whether the attacks of any particular pest can be correlated with some factor influencing plant health, and hence whether the pest can be treated through the plant, should always be borne in mind; but in general the incidence of pests is determined by the interaction

of a large number of more or less independent factors, of which plant health is only one; others are climate, varietal resistance, natural enemies, etc. In field observations it is impossible to disentangle satisfactorily the effect of the health of the plant from other factors; for this reason the questions arising out of the effect of climate and of plant health on insect abundance cannot be finally settled without detailed experiments under completely controlled conditions."

530. Annotated Host List of Uganda Parasitic Fungi and Plant Diseases. V. By C. G. Hansford. (*E. Afr. Agr. Jour.*, iii., **4**, 1938, p. 319.) A continuation of previous lists.

[*Cf.* Abstrs. **692**, Vol. XIV., **133**, **357**, Vol. XV., of this Review.]

531. Establishment and Spread of Moulds and Bacteria on Cotton Roots by Seed and Seedling Inoculation. By M. B. Morrow *et al.* (*J. Agr. Res.*, 56, **3**, 1938, p. 197.) A study of plants from a field infested with *Phymatotrichum omnivorum* (Shear) Duggar has demonstrated that organisms introduced by inoculated cottonseed and by inoculum furnished to the cotton seedling have been established in the rhizosphere of the plant. This conclusion is based upon recovery of the introduced organisms in appreciably greater numbers from inoculated plants than from those not receiving inoculum.

532. Studies on the Infection of Cotton Seedlings by *Phymatotrichum omnivorum*. By L. Henderson. (*Amer. J. Bot.*, xxiv., **8**, 1937, p. 547. From *Rev. App. Mycol.*, xvii., **3**, 1938, p. 172.) Using a culture medium (either as liquid or in sand) suitable for green plants with sufficient dextrose added to permit the growth of the cotton root-rot fungus, *Phymatotrichum omnivorum*, experimental infections were carried out under controlled conditions, the Acala cottonseed used being disinfected and the seedlings raised under sterile conditions before transference to the culture tubes inoculated with the fungus. The results showed that infection of the cotton seedlings occurs at the surface of the medium only in the presence of oxygen approximating to atmospheric concentrations. Water-logged conditions in the soil, therefore, would tend to prevent infection, which would be limited to the moist soil surface above the water table. The thermo-stable staling products of *P. omnivorum* effectively check the growth of cotton roots and might be expected to check the development of the plant in the field, but probably this does not take place, since the staling products are adsorbed and decomposed. Cultures of the fungus freshly isolated from field material show higher rates of growth and infection than they exhibit after culture for several months. Virulence of the fungus is largely a matter of vigour of growth, but cultures attenuated by prolonged growth on artificial media may be reactivated by two or more passages through living cotton plants. In the field, therefore, rapid spread would not be expected from saprophytic sources of infection, but only from the fungus in an active parasitic phase. The interpolation of a resistant rotational crop may therefore decrease subsequent infection, whereas susceptible weeds may be the means of perpetuating virulent cultures over a period when cotton is not grown.

533. Carbon and Oxygen Requirements of the Cotton Root-Rot Organism, *Phymatotrichum omnivorum*, in Culture. By E. J. Moore. (*Phytopathology*, xxvii., **9**, 1937, p. 918. From *Rev. App. Mycol.*, xvii., **2**, 1938, p. 109.) *Phymatotrichum omnivorum*, the agent of cotton root rot in the United States, was experimentally shown to be capable of utilizing for nutrient purposes a large variety of carbon compounds, including dextrose, levulose, galactose, maltose, sucrose, lactose, mannite, xylose, inulin, dextrin, soluble starch, potato starch, maize starch, glycerine, and cellulose. Acidification occurred rarely in cultures with glycerine or cellulose as the source of carbon, and never in dilute root

decoctions or in the controls without carbon, but it took place in all the other carbohydrate media. Growth may occur with or without acidification of the medium. Agar cultures are somewhat more favourable than liquid ones to the development of *P. omnivorum*, and show considerably more rapid acidification in spite of being more highly buffered. The activities of the fungus are checked by anaerobic conditions; they are stimulated by the presence of 42 per cent. oxygen (in liquid cultures only), but depressed by 10½ per cent. (slightly in agar and markedly in liquid media). Expressing the growth of *P. omnivorum* and the acidification of the substratum as utilization quotients, the averages are much less for liquid than for agar cultures at the oxygen concentrations tested. In submerged cultures the quotients vary directly with the oxygen concentration. In agar cultures the highest utilization quotient occurs in normal atmospheric oxygen, which is near the optimum concentration for exposed mycelium. The metabolic processes of the fungus are thus closely associated with the oxygen supply to the mycelium.

534. CONTROL OF ROOT ROT BY CROP ROTATION. By H. E. Rea. (*Int. Cott. Bull.*, xvi., **62**, 1938, p. 228.) A marked reduction in root rot of cotton was secured at the Blackland Experiment Station at Temple, Texas, from 1931 to 1936, when cotton was planted on the same land only once in four years, compared with cotton planted on the same land every year. Root rot killed only 25 per cent. of the cotton plants on the rotated land as against a kill of 67 per cent. on non-rotated land. Cotton in the four-year rotation made an average yield of 321 lb. of lint per acre, while non-rotated cotton yielded only 237 lb. During the time cotton was not planted oats, corn, and grain sorghum were grown, these, in common with all other grass plants, both wild and cultivated, being immune to root rot.

535. RELATION OF SOIL ACIDITY TO COTTON ROOT ROT. By J. J. Taubenhaus and W. N. Ezekiel. (*Texas Sta. Bull.* 545, 1937. From *Exp. Sta. Rec.*, 78, **1**, 1938, p. 61.) Following inoculation of *Phymatotrichum omnivorum* into cotton plants in adjoining containers filled with soils varying spontaneously in pH, the original incidence of root rot, its rate of spread, and the overwintering of the disease were greater in the alkaline than in the acid soils. Many other tests under controlled conditions and with pH adjustments by various means indicated that, in general, only low percentages of infection or overwintering occurred in soils more acid than pH 5·0, while at pH 8·0 to 8·5 high degrees of infection were obtained and the disease killed large numbers of plants for years thereafter. Additions of manure, fertilizers, or trace elements failed to reduce the overwintering of root rot. Cotton plants proved more tolerant to artificial "alkali soil" produced by additions of sodium carbonate than did the root-rot fungus. Sulphur applied in relatively large amounts to the less calcareous soils acidified the soils, but also injured the roots. Smaller applications were without injury, and in various tests proved temporarily beneficial, or until the soil shifted back toward neutrality.

536. EXPERIMENTS WITH MOULD INOCULATION IN COTTON ROOT-ROT AREAS. By C. Thom and M. B. Morrow. (*Pro. Soil Sci. Soc. Amer.*, 1936, **1**, 1937, p. 223. From *Rev. App. Mycol.*, xvii., **3**, 1938, p. 172.) Following up King's hypothesis that cotton root rot (*Phymatotrichum omnivorum*) becomes dominant as a result of the continuous production of the crop on certain neutral to alkaline soils, the writers found that few or none of the moulds shown by recent studies to be antagonistic to the pathogen were present in rot-infected areas. A selected series of such moulds—*e.g.*, *Trichoderma* (? *lignorum*)—inoculated into experimental plots were recovered in sufficient numbers to justify further investigations along the same lines.

537. On the Penetration of *Fusarium buharicum* into Cotton Seedlings. By V. A. Yablokova. (In Russian.) (*Pl. Prot.*, 13, Leningrad, 1937. From *Rev. App. Mycol.*, xvii., 2, 1938, p. 108.) The results of the experiments described in this note showed that spores of *Fusarium buharicum* sprayed on two-day-old seedlings of the local cotton variety No. 1450 (highly susceptible) and of the American Upland No. 1306 (highly resistant or immune). penetrated the unwounded cortex of both hosts at the collar. The parasite spread to the other tissues of the susceptible host, eventually reaching the pith, but in the resistant variety its progress was soon inhibited by the death of the invaded areas and the accumulation in the tissues of a substance which was apparently toxic to the fungus. Inoculations of seedlings of both varieties at a later stage of development gave negative results. Further work is in progress to establish the nature of the resistance in the Upland cotton to *F. buharicum*.

538. Lysis of the Causal Organism of Cotton Wilt, *Verticillium dahliœ*, induced by Certain Myxobacteria. By E. V. Kononenko. (*Microbiol.*, vi., 6, p. 699, U.S.S.R., 1937. From *Rev. App. Mycol.*, xvii., 4, 1938, p. 240.) (In Russian, with English summary.) Most of the soils examined in Armenia were found to contain myxobacteria (*Polyangium* and *Myxococcus* spp.) antagonistic to the agent of cotton wilt (*Verticillium dahliœ*), lysis of the mycelium of which was induced by contact with either small clots of infested soil or pure cultures of the organisms in question. This antagonistic relationship finds expression under natural conditions as well as in the laboratory, the bacteria being capable of hindering sclerotial development and destroying the young mycelium in the soil.

539. A Textbook of Plant Virus Diseases. By K. M. Smith. (J. and A. Churchill Ltd., London, 1937. Price 21s. From *Rev. App. Ent.*, xxvi., Ser. A, 2, 1938, p. 68.) By the classification adopted in this textbook, the viruses that are chiefly associated with a particular plant are grouped together and differentiated by numbers, the synonyms of each being given. The viruses are placed in the order of their plant hosts; first the properties and modes of transmission (including transmission by insect vectors) of the virus are discussed, and then the diseases caused by it, arranged in order of their plant hosts, are described. In an appendix the common symptoms of each virus disease of each plant are listed under the scientific name of the plant, together with the virus that causes it and a page reference. The insect vectors are dealt with in some detail in a separate section. A description is given of each insect, together with an account of its life-history and distribution, and lists of its food plants and the viruses it transmits. Aphids are numerically the most important insect vectors of plant viruses; *Myzus persicœ*, Sulz., is associated with twenty-one.

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540. A Swahili Dictionary of Plant Names. By P. J. Greenway. (Govt. Printer, Dar-es-Salaam. Sh. 3. From *E. Afr. Agr. Jour.*, iii., 4, 1938, p. 312.) A pocket volume of 112 pages of " closely packed information, providing a clue to the connection between plant (botanically defined) and plant name."

541. Sap Ascent in the Tree. By J. H. Priestley. (*Sci. Prog.*, London, 30, 117, 1935, p. 42. From *Exp. Sta. Rec.*, 77, 4, 1937, p. 456.) The author first presents some criticisms of the cohesion theory of sap ascent and then reviews recent studies (especially his own) on vessel differentiation and water movement into the bud. His " main thesis has been twofold: (1) That the cohesion hypothesis does not rest upon a satisfactory experimental basis, and that (2) the movement

of water into the expanding leaves in spring is associated with processes of growth and differentiation both in leaf and woody axis which are entirely neglected at present in the orthodox treatment of the problems of sap ascent."

542. Discussion of Cotton Experiment Methods. By H. T. Wang. (*J. Agr. Ass. China,* 1933, No. 116, p. 47. From *Pl. Bre. Absts.*, viii., 3, 1938, p. 261.) The author formulated a programme for cotton breeding in which it was suggested that boll selection should be practised for both American and Chinese cotton varieties. Genetic purification should take place, according to the author, in the first three years. The first year should be devoted to field observation only, while for the second year replications should be planted with no standard variety as control, and the yield data analyzed by Richey's moving average method. For the third year randomized blocks, and for the fourth year the same method or the Latin square arrangement should be employed. Detailed procedures for the analysis of variance as well as the moving average methods are presented.

543. Scientific Methods in Soviet Plant Industry. By N. Vavilov. (*Socialist Reconstruction of Agriculture* [U.S.S.R.], No. 12, 1937, p. 33. From *Pl. Bre. Absts.*, viii., 3, 1938, p. 223.) The author defends the law of homologous variations on the ground that it has led to the discovery of an immense number of new forms of cultivated plants. He further refers to the important rôle that local varieties have played in breeding work carried out under his direction, the value of many of the forms obtained in the expeditions abroad and the use of wide crossing, on the lines first indicated by Michurin, the most promising results of these crosses being cited.

544. Terminology on Photoperiodism and Vernalization. By A. E. Murneek. (*J. Amer. Soc. Agron.*, 29, 4, 1937, p. 332. From *Exp. Sta. Rec.*, 78, 3, 1938, p. 327.) A Missouri Experiment Station contribution defining thirteen terms.

545. Does "Formal Genetics" give anything of Practical Use for the Production of New Varieties? By L. Delaunay. (*Socialist Reconstruction of Agr.* [U.S.S.R.], No. 12, 1936, p. 59. From *Pl. Bre. Absts.*, viii., 3, 1938, p. 222.) The author points out that most of the crop varieties at present cultivated would not have existed were it not for genetical theory, especially the principle of pure lines, having become part of the normal breeding method. He admits that most, if not all, so-called pure line varieties are still mixed populations, but maintains that this does not imply the uselessness of pure lines or the method of pure line selection. It is further pointed out that though the method of producing early segregates evolved by Lysenko is excellent, yet it does not remove the necessity of working with large hybrid populations when it is desired to combine earliness with other characters. Some of the methods evolved by breeders for curtailing this work as much as is practicable are outlined, and several established genetical principles are explained for the benefit of critics who have overlooked them.

546. Phytohormones. By F. W. Went and K. V. Thimann. (Macmillan Co., New York, 1937. Price $4.00. From *Pl. Bre. Absts.*, viii., 3, 1938, p. 303.) New lines of development in the rapidly extending study of plant hormones are treated in this work, which includes references to the literature appearing up to the end of 1936; indeed, seventy-seven of the works referred to in the bibliography bear the date 1936, a further indication of the rate at which the subject is extending. The work is limited to the consideration of the substances affecting the growth of the higher plants, thus the auxins proper. The growth of the hormone conception as applied to plants is traced by reference to the now

classical experiments, and the methods of measuring auxins, their action on the growth of stems and roots, their transport in the plant, their chemical composition, and their rôle in tropisms are among the various aspects of the subject treated at some length. Of rather more particular interest to plant breeders will be the sections on root formation—*e.g.*, in cuttings—and on cell division as influenced by auxins; thus cambial activity, callus formation, and the associated stem swelling and root formation are stimulated by auxins, as are certain other phenomena such as flower-bud development.

[*Cf.* Abstr. 737, Vol. XIV., of this Review.]

547. THE BIOLOGY OF CROSSING OVER. By C. D. Darlington. (*Nature*, **140**, 1937, p. 759. From *Pl. Bre. Absts.*, viii., **3**, 1938, p. 208.) A brief account of the author's theory of crossing over is given, and the part it plays in evolutionary processes is discussed. By adding the average chiasma frequency per cell to the number of pairs of chromosomes a recombination index is obtained which is a measure of the average total number of independently segregating gene blocks in the species. It appears that a low index has a positive selection value, though the necessity for at least one chiasma per pair of chromosomes for regular meiosis establishes a lower limit. Crossing over in dyscentric structural hybrids causes changes in genetic balance, such changes being an effective means of variation. Suppression of crossing over as a result of small structural changes leads to isolation of chromosomes or parts of chromosomes, and instead of the normal unit of crossing over, the gene, a new unit is established; any gene differences occurring within this segment are held together in more or less permanent combination. This special type of unit gives rise to three important types of discontinuity in Nature. The simplest is that by which two groups which remain interfertile diverge within a species, possible examples being found in *Avena fatua* and *Triticum spelta*, each of which differs from its relatives essentially in a group of genes lying in a part of one chromosome. The second type is that by which the sex-determining chromosomes, X and Y, come to be distinguished. The third type is that which arises between chromosomes in establishing a permanent hybrid of the *Œnothera* type.

[*Cf.* Abstr. 320, Vol. XIII., of this Review.]

548. CHROMOSOMES, SEGREGATION AND HYBRID VIGOUR. By A. Sapehin. (*Socialist Reconstruction of Agriculture* [U.S.S.R.], **12**, 1936, p. 69. From *Pl. Bre. Absts.*, viii., **3**, 1938, p. 221.) The evidence of a number of observers is adduced to prove that segregation takes place at tetrad formation. This, together with a number of other facts such as linkage phenomena, are shown to be irreconcilable with Lysenko's view of inheritance. The genetical conception of the interaction of the gene and the environment to produce the character is shown to be more exact than Lysenko gives credit for, and the value in practical breeding work of genetical principles such as multiple factors, heterosis, etc., is illustrated. It is pointed out that no variety is a pure line in the absolute sense, and Lysenko's results are shown to be susceptible of an orthodox genetical explanation. It is nevertheless admitted that much genetical work is too abstract and neglects the urgent practical problems of the plant and animal breeders.

549. ON SOME INTERSPECIFIC CROSSINGS IN THE GENUS *Gossypium*. By N. N. Konstantinov. (*C. R.* [*Doklady*] *Acad. Sci. U.R.S.S.*, **17**, 1937, p. 485. From *Pl. Bre. Absts.*, viii., **3**, 1938, p. 261.) Using *Gossypium lanceœforme* Miers. (*Thurberia thespesioides* Asa Gray) as the male parent, crosses were made with the following varieties as female parent: *G. barbadense* (4·4), *G. peruvianum* (1·8) *G. hirsutum* (4·3) and *G. arboreum* (8·5). The numbers in brackets are the percentage of bolls obtained. Differences were noted between the particular

variety, race or line of the species used, some being more successful than others. All the bolls were abnormal in development and the seeds germinated with difficulty. The characteristics of the F_1 progeny of the crosses are briefly described. Of the three different strains of *G. hirsutum* used, only the progeny from one survived beyond the first season. This hybrid, though somewhat retarded in growth, was more or less normal. From the results it is concluded that the species *Thurberia thespesioides* should be included in the genus *Gossypium*.

FIBRES, YARNS, SPINNING, WEAVING, ETC.

550. Cotton Bale Identification Tag: Specification. By J. W. Wright and G. E. Gaus. (*U.S. Dept. Agr., Bur. Agr. Econ., Permanent Identification of Cotton Bales*, 1937. From *Summ. of Curr. Lit.*, xviii., **7**, 1938, p. 189.) This report discusses the need for a means to identify the origin of a cotton bale that cannot be removed without breaking up the bale, and is resistant to fire. An account is given, with illustrations, of experimental work on the problem, and the specification is reproduced of an approved tag made of sheet steel and plated with cadmium after the name of the State, the gin number, crop year, and other information have been stamped into the metal. The tag is 3½ inches by 1¾ inches and is attached by a loop to an "anchor wire" 28 inches long, with a loop at the far end. The wire is laid in the bale at the ginnery. An account is also given of "nail" types of identification tags that proved to be unsatisfactory. The report concludes with a summary of State laws relating to bale identification.

551. Fibres: Length Measurement. By D. F. Kapadia. (*Textilberichte*, **19**, 1938, pp. 29, 139. From *Summ. of Curr. Lit.*, xviii., **7**, 1938, p. 204.) The determination of the staple length of cotton is discussed, and it is shown that the value obtained by the hand-stapling method lies between the mean value and the most frequent length and is about 8 per cent. higher than the mean. The sledge apparatus and the Baer apparatus are discussed, and an improved form of the latter is described. Results obtained with the three devices are compared. Statistical conceptions involved in the determinations of fibre lengths are outlined, and the significance of measurements of mean length, mean observation, most frequent length, effective length, super-mean, upper quartile, variation coefficient, quartile variation and percentage dispersion, is discussed. It is pointed out that the mean observation provides a better standard for the evaluation of group variables of a staple than the mean length. The values obtained with the sledge apparatus and the improved Baer apparatus are more accurate for determinations of the most frequent length, the super-mean, the upper quartile and the effective length than those obtained by the apparatus described by Miss Clegg. The importance of a knowledge of degree of variability is pointed out, and the percentage short fibre content is briefly discussed.

552. Certain Characters of Cotton Fibre as affected by Plat Placement. By G. N. Stroman. (*J. Amer. Soc. Agron.*, 29, **8**, 1937, p. 638. From *Exp. Sta. Rec.*, 78, **1**, 1938, p. 38.) From an analysis of variance made at the New Mexico Experiment Station on 8 random check rows of 10 plants each of College Acala in 1933, 7 rows in 1934, and 10 rows in 1935, the significant mean squares in the source of variation of the between means of rows seemed to indicate that certain qualities of lint, as especially denoted by length of lint and percentage 1⅛-plus fibres, were affected by placement of plats. Such variation appeared due to differences in the soil. Relationships of the characters as shown by the correlation coefficient of different sources of variation seemed to change to some degree as the characters themselves were affected.

553. Design of an Impact Tester to Measure Resistance and Extension. By W. L. Balls. (*Bull. No.* 194, Tech. and Sci. Serv. Min. of Agr. Egypt, 1938.) A description, with diagrams, of the instrument, the need for which arose in testing the strength of cotton hairs. "The outstanding characteristic of the design is the employment of three separate pendulums, identical in period and in phase, each with its special purpose: (*a*) The cradle, to present the test material to the arresting anvil, and to prevent rebound therefrom; (*b*) the hammer, or ballistic pendulum proper, whose known energy breaks the material in reaction with the anvil; (*c*) the recorder, carrying a drum on which a stylus connected to the hammer traces their relative movements, and hence the velocity (or energy) of the hammer in terms of their relative displacements. By this device of a recorder moving with the hammer at first, the scale of the movement of the hammer at break was opened out and made clearly legible. The duration of the actual break with cotton is usually from 0·010 to 0·020 second, and the events during this period can be dissected out at intervals as small as 0·0002 second."

554. Cotton Hair: Growth and Structure. By D. B. Anderson and T. Kerr. (*Ind. Eng. Chem.*, **30**, 1938, p. 48. From *Summ. of Curr. Lit.*, xviii., **5**, 1938, p. 140.) An account is given of the results of a study of the growth and structure of the cotton hair, based on observations of the Mexican Big Boll variety of American Upland cotton grown under field conditions in 1936. The results are considered in conjunction with the observations of other investigators. The observations show that in the primary wall of the cotton hair, which contains cellulose and pectic substances, the cellulose micelles are grouped into delicate anastomosing threads which have at least two systems of orientation: (*a*) a flat right-hand spiral, (*b*) a flat left-hand spiral, and probably also (*c*) a transverse position. All three systems seem uniform over the entire surface of the hair cell. The secondary wall, which first begins to appear on about the sixteenth day after the opening of the flower, is composed of many lamellæ of cellulose. The lamellæ are not separated from one another by non-cellulosic substances, but represent dense and less dense areas of cellulose. The layers are formed of systems of spirally wound branching threads, and the direction of the spiral is reversed at frequent intervals. Frequently the pattern of spirals first appearing in the secondary wall is not similar to that in subsequent layers of the wall. Most of the layers of the wall, however, follow a pattern which is established soon after secondary thickening has begun. When the boll opens and the fibres dry out, the wall becomes twisted and the direction of the twists (convolutions) conforms to that of the spirally wound threads that make up most of the cell wall. The existence of growth rings in the cotton hair and explanations of their mode of formation are discussed. Evidence for and against the ellipsoidal particle theory of cellulose structure is discussed, and it is shown that the micellar theory seems to offer a more satisfactory explanation of the physical properties of cotton hairs.

555. Cotton Botany and the Spinning Value and Hair Properties of Cotton Lint. By J. B. Hutchinson and G. K. Govande. (*Ind. J. of Agr. Sci.*, viii., **1**, 1938, p. 21.) The technological data available for standard Indian cottons have been analyzed according to botanical relationships. It is shown that the different botanical types differ greatly in mean spinning values and hair properties. The greatest differences are between the short, coarse, low-spinning *Gossypium arboreum* var. *neglectum* forma *bengalensis* of Northern India and the other botanical groups. The other groups differ in hair weight, the Uplands being the finest and the *herbaceum* the coarsest, but have very similar hair lengths and spinning values.

The data show that the reputation of India as a producer of coarse-stapled

cotton depends almost entirely on one of the four botanical types now cultivated. As it has already been shown (Hutchinson and Ghose, 1937; Hutchinson, 1937) that the coarse northern *arboreum* type has invaded most of the areas in which it now predominates in quite recent times, it is concluded that India has become a producer of coarse cottons by force of economic circumstances, and not on account of any inferiority in her indigenous cottons. It is shown that the introduced Upland cottons differ very little from the superior indigenous types in spinning value. If adequate botanical and technological surveys are made of the range of variability available in the indigenous species, improvement in quality is likely to be attained as rapidly with them as with exotic types. The relative importance of differences in crop variety and in environment is examined, and it is shown that differences in hair properties and spinning value due to differences in environment are very small compared with those due to crop variety. Also, correlations between hair properties and spinning value are very much higher when calculated from differences in crop variety than from differences in environment. This is fortunate from the plant-breeding point of view, since it minimizes the errors which will arise from the estimation of strain differences in spinning value from hair characters measured on small quantities of cotton from progeny rows. The swollen hair diameter method of determining fineness is discussed, and it is concluded that if it is satisfactory after more extended trial, it will put the quantitative study of fineness within the reach of the plant breeder. Its importance is emphasized in enabling the plant breeder to select for high ginning percentage without the risk of loss of quality.

[*Cf.* Abstrs. **380**, Vol. XIV., and **366**, Vol. XV., of this Review.]

556. Spinning Problems: Discussion. Southern Textile Association. (*Cotton, U.S.*, 101, **11**, 1937, p. 55. From *J. Text. Inst.*, xxix., **2**, 1938, A72.) The following subjects are discussed: Use of artificial rubber for top rollers; high draft in roving; relation between spindle speed and twist on slubbers; carding staple fibre.

557. Short Staple Cottons: Combing. By H. Leittretter. (*Klepzig's Textil Z.*, **41**, 1938, pp. 73 and 83. From *Summ. of Curr. Lit.*, xviii., **6**, 1938, p. 160.) The improvement in yarn quality which results from the use of combed cotton is discussed, and it is pointed out that a combing treatment can with advantage be substituted for the second carding treatment in the processing of short staple cottons. Modern combing equipment suitable for this purpose is discussed. The combing operation should be carried out in such a way that the comber waste amounts to only about 5 to 6 per cent. The disadvantages of the double carding method and the advantages of the combing treatment are described.

558. Neps: Nature, Origin, Prevention and Removal. Saco-Lowell Shops. (*Saco-Lowell Bull.*, ix., No. 5, 1937, p. 24. From *Summ. of Curr. Lit.*, xviii., **4**, 1938, p. 100.) The nature and origin of neps are discussed and precautions to be taken in opening, scutching, and carding processes in order to prevent the formation of neps and to facilitate the removal of those already present are briefly described. Photo-micrographs of various types of neps are given.

559. Textile Machines: Construction. By P. Beckers. (*Leipz. Monats. Text. Ind.*, **53**, 1938. From *Summ. of Curr. Lit.*, xviii., **6**, 1938, p. 176.) Problems associated with the construction of textile machines are discussed and methods for the study of the effects of vibration and fatigue, extension measuring methods, and optical methods for the study of stresses depending on the use of polarized light are briefly described. The evaluation of results obtained in investigations of tension distributions in machine parts is briefly discussed and the practical application of strength laws is illustrated by a study of examples. The effects of corrosion are mentioned.

560. COTTON YARN: STRENGTH AND COUNT VARIATIONS. By F. H. Martin, (*Cotton*, U.S., 102, **1**, 1938, p. 52. From *Summ. of Curr. Lit.*, xviii., 6, 1938, p. 174). Particulars are recorded of the processing of $1\frac{1}{32}$-inch cotton into 20's yarn. twist factor 4·75, in an American mill, where the routine testing practice consisted in examining seven bobbins a day for forty days and taking the average. The lea weights counts, lea strengths and count strength products from such a test are recorded and analyzed in detail by means of graphs and frequency arrays. It is pointed out that although the average count of 19·92 and breaking load of 111·3 lb. were good, the method of dealing with the figures entirely masked the irregularity of the yarn.

TRADE, PRICES, NEW USES.

561. WORLD COTTON CROP: SUPPLIES AND PRICES. By M. Tcherkinsky. (*Int. Rev. Agr.*, **28**, 1937, pp. 353-382 E. From *Summ. of Curr. Lit.*, xviii., **4**, 1938, p. 127.) The author reviews " the events which have struck the world cotton market and driven it off its traditional path " and seeks to interpret their significance. The review is divided under the following headings and appropriate statistics are tabulated: Evolution of world production and trade, 1929-1936; the share of the three main classes of commodities (foods, raw materials, manufactures) in world trade; the share of cotton in world trade; world cotton production; evolution of cotton prices; relation between agricultural and industrial prices; cotton policy in U.S.A.; cotton exports; world cotton consumption; consumption of rayon in relation to that of natural fibres; the U.S. Soil Conservation and Domestic Allotment Act; new trade agreements of the U.S.A.

562. COTTON OPERATIVES: PHYSICAL STRAIN. By E. Kidd. (*Text. Rec.*, 55, **657**, 1937, p. 22. From *Summ. of Curr. Lit.*, xviii., **3**, 1938, p. 94.) The author calculates the weights of cotton carried per week by blowroom, cardroom and spinning operatives. The range is from about 53½ tons for cotton mixers to 1½ tons for ring tenters.

563. THE WEAVER'S WAGE. By E. M. Gray. (Pubd. *Manchester Univ. Press.* From *Int. Cotton Bull.*, xvi., **62**, 1938, p. 288.) The author expresses doubt as to whether weavers on the new systems have a more arduous task than weavers on the ordinary system. He affirms that wages on the new systems are much better, and states as an example that, whereas average earnings on the ordinary system are 39/10, those on the six-loom system are 46/8½, or 17 per cent. more, and those on the more-than-six-loom system are 63/11½, or 60 per cent. more.

MISCELLANEOUS.

564. FOREIGN COTTON PRODUCTION AND ITS INCREASE. By P. K. Norris. (*U.S. Dpt. of Agr., Bur. of Agr. Econ.*, 1938.) A brief discussion of cotton growing in the six major producing countries—United States, India, China, Russia, Egypt and Brazil—and in the most important of the minor group. Mention is made of the work of the British Cotton Growing Association and of the Empire Cotton Growing Corporation in the establishment of cotton growing in the African colonies. From this discussion it would appear that at last America is beginning to take seriously the probable effects of foreign competition.

565. THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY. The Thirtieth Annual Report contains the report of the Governing Body for the year ended July 31, 1937, and an account of the work of the various departments of the College. The total number of students registered was 1,015, or 9 less than the previous year. On the results of research work done at the College, 90 higher

degrees of the University of London were awarded, and 110 higher diplomas of the Imperial College, a total of 200. The number of B.Sc. degrees awarded to Imperial College students was 167, including 114 with Honours. The grand total of distinctions for 1936-37 was 542. In connection with the Appointments Board, of 190 students who had completed their studies, most obtained employment quite soon, and by Easter, 1937, only six remained unemployed. The titles of 251 papers published during the year are included in the report.

566. THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE. The Principal's Report for 1936-37 records with deep regret the death of the Chairman of the Governing Body, Sir James Currie, and of five members of that Body. The College also suffered severe loss through the death of Dr. H. R. Briton-Jones, Professor of Mycology. The disturbances and riots that occurred throughout Trinidad in June caused much anxiety, but the work of the College was actually interfered with only for one or two days.

Long-range research as usual centred round the four main crops of the island —sugar-cane, cacao, bananas, and citrus—and the work is described. Brief accounts are also included of the investigations carried out by the Departments of Agriculture, Botany, Chemistry and Soil Science, Economics, Entomology and Zoology, and Mycology and Bacteriology. The number of students in residence was 45. During the year 14 Associateships and 9 Diplomas were awarded. Thirty-one scientific papers were published, including those written for *Tropical Agriculture.*

PERSONAL NOTES

RESIGNATIONS AND APPOINTMENTS

Sir Geoffrey Evans is shortly resigning his post as Principal of the Imperial College of Tropical Agriculture, Trinidad, on appointment as Economic Botanist, Royal Botanic Gardens, Kew, in succession to Mr. H. C. Sampson. His departure from Trinidad will unfortunately bring to an end the invaluable help he has been able to give to the Corporation during the past five years as Controller of their Research Station in the island.

On the retirement of Mr. M. A. Bailey on July 9, Mr. T. Trought is leaving the Corporation's service on appointment as Director, Agricultural Research Service, Sudan. Prior to holding this post Mr. Bailey was a member of the Corporation's staff from 1925 to 1931. As a result of the reorganization of the Plant Breeding Section Mr. S. H. Evelyn is being transferred from St. Vincent, and will proceed to the Sudan in 1939 as an Assistant Plant Breeder, after taking a refresher course in England. The post of Cotton Officer in St. Vincent will be filled by Mr. H. L. Manning, who for the last three years has been an Assistant Agricultural Officer in British Honduras.

Dr. G. M. Wickens has been appointed as Plant Pathologist at the Cotton Experiment Station, Barberton, South Africa, with effect from August 1, 1938.

OFFICERS ON LEAVE

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes " home " on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if

Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the time of writing the following officers are on leave, or will shortly be arriving, in this country from cotton-growing countries:

Ceylon	Dr. P. C. Sarbadhikari.
Cyprus	Mr. A. Pitcairn.
Gambia	Mr. F. W. Hall.
"	Mr. V. F. O. Olivier.
Gold Coast	Mr. J. D. Broatch.
" "	Mr. G. S. Cotterell.
" "	Mr. R. I. W. Grimm.
" "	Mr. L. J. Packham.
" "	Mr. C. L. Skidmore.
" "	Mr. B. T. Steemson.
" "	Mr. J. T. H. Stein.
Kenya Colony	Mr. G. H. G. Jones.
" "	Mr. C. O. Oates.
" "	Mr. N. D. Spranger.
" "	Mr. H. Wolfe.
Nigeria	Mr. F. E. Buckley.
"	Mr. G. F. Clay.
"	Mr. M. W. Gibbon.
"	Mr. F. D. Golding.
"	Mr. L. P. Henderson.
"	Mr. E. T. Holmes.
"	Mr. E. W. Leach.
"	Mr. J. K. Mayo.
"	Mr. J. H. Palmer.
"	Captain H. G. Poynter.
"	Mr. S. D. Ross.
"	Mr. H. D. Urquhart.
"	Mr. C. H. F. Walker.
"	Mr. W. A. Watson.
Nyasaland	Mr. R. Leach.
"	Mr. Colin Smee.
Northern Rhodesia	Mr. C. J. Lewin.
Sierra Leone	Mr. F. C. Deighton.
" "	Dr. F. J. Martin.
" "	Mr. G. M. Roddan.
Sudan	Mr. W. L. P. Cameron.
"	Dr. F. Crowther.
"	Mr. H. E. King.
"	Mr. G. F. March.
"	Mr. R. T. Paterson.
"	Mr. W. Ross.
Tanganyika Territory	Mr. L. R. Doughty.

Tanganyika Territory	Mr. B. J. Hartley.
" "	Mr. C. Harvey.
" "	Mr. R. D. Linton.
" "	Mr. T. Marshall.
" "	Mr. J. Robertson.
Uganda	Mr. C. E. J. Biggs.
"	Mr. A. M. Gwynn.
"	Mr. C. G. Hansford.
"	Dr. W. S. Martin.
"	Mr. G. B. Masefield.
"	Mr. G. W. Nye.
"	Mr. E. Williams.
West Indies: *Dominica*	Mr. F. G. Harcourt.
West Indies: *Trinidad*	Mr. G. A. Jones.
" " "	Mr. E. J. Gregory.

The following officers of the Corporation's staff abroad are on leave, or will shortly be arriving, in this country:

Nyasaland	Mr. H. C. Ducker.
South Africa	Mr. P. A. Bowmaker.
" "	Mr. F. R. Parnell.
" "	Mr. F. S. Parsons.
" "	Mr. M. F. Rose.
" "	Mr. D. F. Ruston.
Southern Rhodesia	Mr. A. H. McKinstry.
Sudan	Mr. R. L. Knight.
"	Mr. T. Trought.
West Indies: *Trinidad*	Mr. J. B. Hutchinson.
" " "	Dr. E. Phillis.

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THE EMPIRE COTTON GROWING REVIEW

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TWENTY-FIVE YEARS OF COTTON PRICES*

BY

JOHN A. TODD, M.A., B.L.

In a paper on Empire Cotton Growing read by Mr. S. Milligan at the Empire Exhibition at Glasgow in August, he used a diagram (prepared by the writer) of the course of American cotton prices from 1913 to 1938 based on the seasons' average spot prices in Liverpool of American Middling; for American is still regarded as the basis of the world's price of cotton. It may be interesting to supplement this by a similar record of comparative prices of Egyptian and other varieties, and the writer has compiled a list of all these prices so far as available for the period of twenty-five years, giving for Egyptian and other varieties both the seasons' actual prices and the percentage of these on American. In the double diagram on page 282 the upper half gives the course of American prices and the lower the prices of other varieties as percentages on American.

The *information in the table has been mainly derived from the* annual circulars of the Liverpool Cotton Association. It will be noted that for some of the outside growths the series of quotations begins only about 1922 to 1924. The figures given are the earliest annual averages supplied by the Liverpool Cotton Association, though as a matter of fact some of the quotations had been given weekly for some years before that.

The general trend of cotton prices as shown by the price of American can be seen at a glance in the upper half of the diagram. The pre-war level of 1913-14 was a fairly high figure owing to the steady increase of the world's demand for cotton of all kinds. The first effect of the war was a sharp fall in the prices of everything

* This article may be taken as supplementary to one by the writer on Comparative Cotton Prices in the first volume of the Review (October, 1924), page 299, which gave the early history of cotton prices and brought the record down to season 1923-24.

SEASON'S AVERAGE SPOT PRICES IN LIVERPOOL, 1913–38.

Season.	American Middling.	*Egyptian.*			*Peruvian.*	*Brazilian.*		*African.*		*Indian.*
		Sakel.	*Uppers.*	*Brown.*	*Tanguis.*	*Pernam.*	*São Paulo.*	*East.*	*West.*	*Oomra No. 1.*
			F.G.F.		*Good.*	*Fa*	*ir.*	*G.F.*	*Mid.*	*Fine.*
1913–14	7·27	—	—	9·45	—	7·47	—	—	—	5·88
% on American		—	—	*130*	—	*103*	—	—	—	*81*
1914–15	5·22	—	—	7·34	—	5·71	—	—	—	4·46
		—	—	*140*	—	*109*	—	—	—	*85*
1915–16	7·51	—	—	10·42	—	8·22	—	—	—	6·09
		—	—	*139*	—	*109*	—	—	—	*81*
1916–17	12·33	25·68	—	21·56	—	13·04	—	—	—	10·32
		208	—	*175*	—	*106*	—	—	—	*84*
1917–18	21·68	30·97	—	—	—	24·13	—	—	—	18·78
		143	—	—	—	*111*	—	—	—	*87*
1918–19	19·73	27·85	—	—	—	23·96	—	—	—	18·13
		141	—	—	—	*121*	—	—	—	*92*
1919–20	25·31	60·34	—	—	—	30·00	—	—	—	19·23
		239	—	—	—	*119*	—	—	—	*76*
1920–21	11·89	30·24	—	—	—	13·24	—	—	—	9·20
		254	—	—	—	*111*	—	—	—	*77*
1921–22	11·37	19·75	—	—	—	11·40	—	—	—	9·60
		174	—	—	—	*100*	—	—	—	*85*
1922–23	14·92	17·29	—	—	16·87	14·62	—	—	—	11·14
		116	—	—	*113*	*98*	—	—	—	*75*
1923–24	17·66	21·55	20·89	—	20·15	18·20	—	—	—	13·35
		122	*118*	—	*114*	*103*	—	—	—	*74*
1924–25	13·76	29·82	19·44	—	18·21	14·67	13·36	16·48	13·36	11·95
		217	*138*	—	*132*	*107*	*97*	*120*	*97*	*87*
1925–26	10·77	20·05	14·42	—	15·15	11·09	10·11	13·11	10·43	8·97
		186	*134*	—	*141*	*103*	*94*	*122*	*97*	*83*
1926–27	8·15	15·39	11·60	—	9·95	8·32	7·44	10·19	7·92	7·18
		189	*142*	—	*122*	*102*	*91*	*125*	*97*	*88*
1927–28	11·17	19·39	14·63	—	12·52	11·36	10·71	14·10	10·91	9·21
		174	*131*	—	*112*	*102*	*96*	*126*	*98*	*83*
1928–29	10·52	18·14	12·12	—	12·25	10·72	10·16	12·06	10·50	8·03
		172	*115*	—	*116*	*102*	*97*	*115*	*100*	*76*
1929–30	9·09	14·52	10·47	—	10·44	8·67	8·52	9·67	9·07	6·39
		160	*115*	—	*115*	*95*	*94*	*106*	*100*	*70*
1930–31	5·71	9·06	6·86	—	6·78	5·67	5·59	6·71	5·73	4·02
		159	*120*	—	*119*	*99*	*98*	*117*	*100*	*70*
1931–32	4·82	6·80	5·68	—	6·17	4·86	4·79	5·66	4·84	4·32
		141	*118*	—	*128*	*101*	*99*	*117*	*100*	*90*
1932–33	5·62	7·79	7·01	—	6·98	5·73	5·68	6·60	5·66	4·84
		139	*125*	—	*124*	*102*	*101*	*117*	*101*	*86*
1933–34	6·02	8·05	6·64	—	7·31	5·95	5·93	6·67	5·99	4·52
		134	*110*	—	*121*	*99*	*98*	*111*	*100*	*75*
1934–35	6·93	8·52	7·57	—	7·87	6·62	6·75	7·51	6·84	5·24
		123	*109*	—	*114*	*95*	*97*	*108*	*99*	*76*
1935–36	6·52	9·22	7·48	—	7·60	6·31	6·50	7·10	6·53	5·21
		141	*115*	*Giza 7.*	*117*	*97*	*100*	*109*	*100*	*80*
1936–37	7·11	10·82	8·46	9·73	8·85	6·67	6·87	7·59	7·01	5·29
		152	*119*	*137*	*124*	*94*	*96*	*107*	*98*	*74*
1937–38	4·97	—	6·32	7·42	6·86	4·55	4·90	5·43	4·81	3·83
		—	*127*	*149*	*139*	*92*	*99*	*109*	*97*	*77*

except war materials, and it was not then realized that cotton was to become one of the most important of raw materials. With the progress of the war, however, prices rose steadily to 1917-18, and the short-lived slump after the Armistice in 1918 only served to cut down the acreage for the following year. Owing to adverse weather conditions this resulted in a very small crop, so that when the excessive demand of the post-war boom developed in the summer of 1919 prices were pushed up to a new peak comparable only with the famine prices of the American Civil War. The deflation slump, however, quickly corrected this, but then came three years of appalling damage by boll weevil (1921-23), and prices soared again. Once more, however, the American crop demonstrated its extraordinary powers of recuperation with steadily increasing crops, till 1926 established a new record with a fall of prices to nearly pre-war level.

The usual reaction in a smaller acreage and a smaller crop brought a good recovery in 1927, which lasted until the Wall Street crash of 1929 started the great fall of world prices of all kinds from which we have not yet entirely recovered. The result is that in spite of devaluation the general level of prices for the last eight years has been lower than pre-war. America, as described in the writer's periodical articles on the general situation, has made valiant efforts to maintain the price by crop restriction, but this has only resulted in an enormous increase of Outside Growths, so that last year when America (in spite of restriction) produced another record crop of nearly 19 million bales, the total of Outside Growths for the second year in succession was still higher, so that the total world's production of cotton, excluding linters, in that year was nearly 39 million bales against 25 million bales in 1913-14.

As to Egyptian, in the early part of the period under review, the principal quotation for Egyptian was F.G.F. Brown, which represented the then staple cotton of the Delta, Mitafifi. In 1916, however, the annual quotation was changed to Sakel, and in 1936 Sakel gave place to Giza 7 as the typical long staple variety.

The history of Egyptian prices is largely one of changes in demand. The sharp rise of prices in 1916-17 was due to the increasing demand for tyre fabric in America, and in the post-war boom of 1919-20 this carried Sakel prices up to 239 per cent. on American! American collapsed more quickly in 1920-21 than Egyptian, so that the percentage price of Sakel was actually higher in that year. With the great scarcity of American, however, in 1921-23 the relative price of Egyptian collapsed and there was actually a period when Uppers were cheaper than American. In 1924, partly as the result

of Government intervention, but mainly owing to a record world consumption of Egyptian, the relative prices of Egyptian (especially Sakel) soared again, but this has been followed by a steady decline for ten years which brought Egyptian relative prices down to another low level during season 1934-35. The recovery since then has developed very strongly, including Giza 7 in the past season.

The movement of prices of Uppers since 1923 has been less spectacular because Uppers has always been much more subject than Sakel to competition from other varieties. In the old days before boll weevil the best varieties of American long staple cotton had begun to compete severely with Uppers, especially when it proved possible to apply the then new process of mercerizing to these high-grade American cottons, but the weevil wiped out all these superior varieties of American about 1918-19, and for a time almost the only competition Uppers had to face was from the North Brazilian tree cottons which are represented by the quotation of Brazilian Pernam.

The main varieties of Peruvian then known, Peruvian Rough and Smooth, and Mitafifi, were also to some extent rivals of Uppers, but it was not till the new Peruvian variety, Tanguis, came in about 1922 that Uppers had to face a rival which was for some purposes actually better, for Tanguis is very white and is particularly favoured by the hosiery trade. The result is shown clearly in the diagram where for seven years out of the last ten the annual quotation of Tanguis has been higher than Uppers. Both Uppers and Tanguis, however, have during the last fifteen years had to face an increasing amount of competition from East African cotton, the quality of which is good, though the quantity is still comparatively small.

Reference has been made above to the appreciation of Brazilian Pernam cotton during the period of high prices of Egyptian in 1918 to 1920, but this quickly passed and Pernam sank to a level little above American. The most striking development, however, has been that in recent years Pernam has fallen well *below* American, possibly as the result of the increasing Egyptian crops, but here again is an interesting illustration of the curious way in which the prices of different varieties change about, relatively to American and relatively to each other. During the great scarcity of American cotton in 1921-23 the small but increasing crop of American type in Southern Brazil (São Paulo) proved very helpful, and there were great hopes of its possible increase to really substantial dimensions. The recovery of the American crop, however, in 1924-26, put it for the time being out of court, but one of the remarkable developments of the recent period of American crop restriction has been the steady

increase of the São Paulo crop and since 1933 its relative appreciation in price. For the last four years it has been above Pernam and frequently almost level with the price of American.

The price of West African cotton, another variety of good American type, is given in the table, but has not been put on the diagram because it varies very slightly from American. On the whole it would coincide very closely with the price of São Paulo.

Coming finally to Indian cotton the difficulty there is to get one quotation which is really typical. Oomras still form the bulk of the Indian crop, but by no means the most important part as regards the export trade, especially to Liverpool, which, in spite of recent efforts to promote the use of Indian cotton in Lancashire, still uses far more Broach. For some reason, however, a continuous annual quotation of Broach is not available throughout the whole period. Again, the new American varieties of Indian cotton such as Punjab and Sind American would form a more interesting comparison with American prices. It is probable, however, that the quotation of No. 1 Fine Oomra, of which alone a long record is available, would show much the same trend as the quotations of other Indian varieties. It will be noted from the diagram that relatively the Oomra quotations as a percentage on American fluctuate very widely. This is partly due to the coincidence that often when the American crop was superabundant the Indian crop was comparatively small, but a further explanation is probably to be found in the changing conditions of demand for Indian cotton, especially in Japan, and these conditions have in recent years been largely affected by quotas.

In the present state of the world, where not only the production but also the consumption of so many staple commodities is largely subject to Government control, it would be dangerous to hazard any kind of a prophecy as to what is likely to happen to cotton prices in the future, but one outstanding fact must be noted. As stated in the statistical article in this issue, the American crop has apparently entered upon a new era, for 200 lbs. per acre seems likely to be in future the minimum average yield rather than the maximum. Unless this is countered by still further acreage restriction (this crop was intended to be $10\frac{1}{2}$ million bales !) we must reckon with a substantial American crop in future, but there seems very little likelihood of the other world crops giving up the enormous increase of cotton acreage which they have established in recent years.

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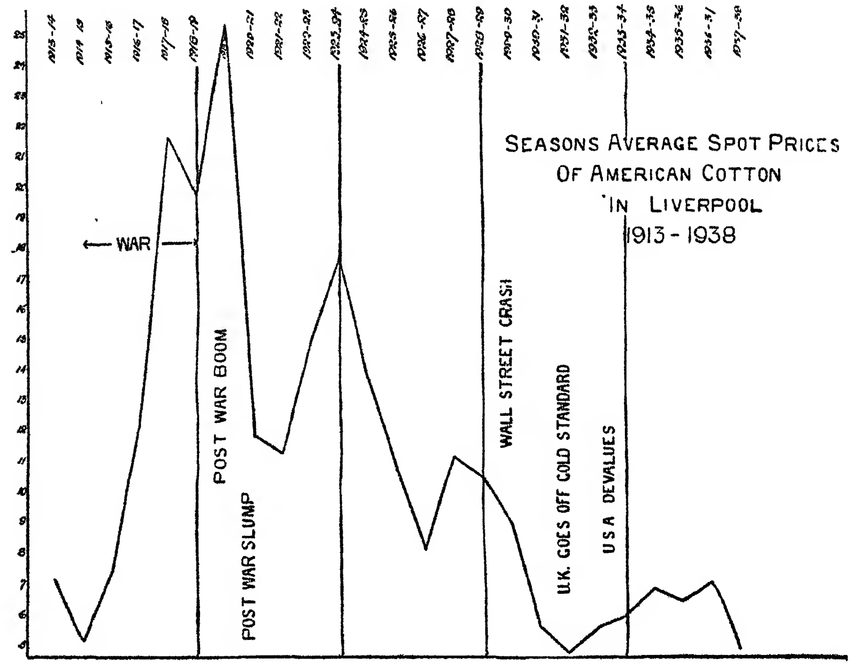
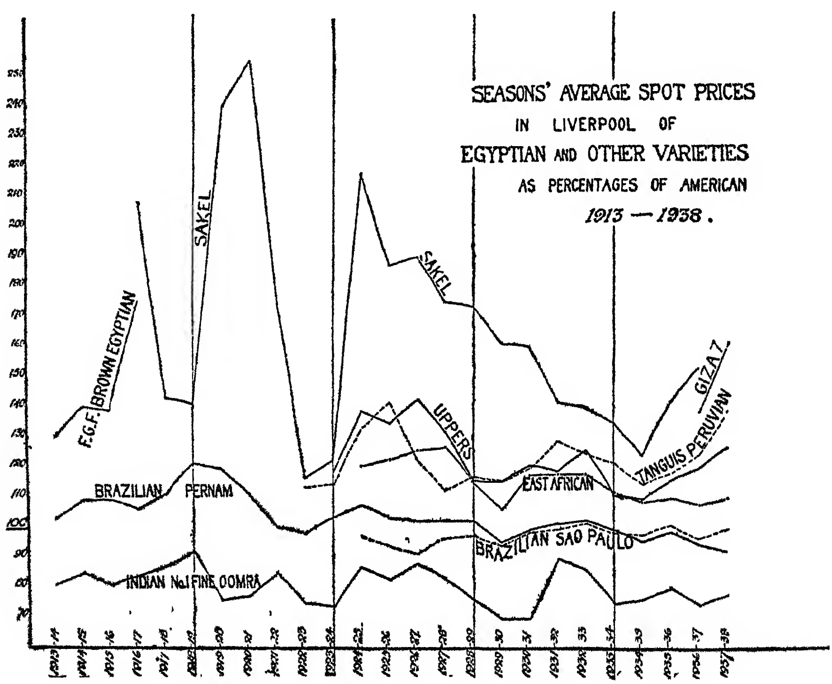

SEASONS AVERAGE SPOT PRICES
OF AMERICAN COTTON
IN LIVERPOOL
1913 - 1938
WAR
POST WAR BOOM
POST WAR SLUMP
WALL STREET CRASH
U.K. GOES OFF GOLD STANDARD
U S A DEVALUES


SEASONS' AVERAGE SPOT PRICES
IN LIVERPOOL OF
EGYPTIAN AND OTHER VARIETIES
AS PERCENTAGES OF AMERICAN
1913 — 1938.
F.G.F. BROWN EGYPTIAN
SAKEL
SAKEL
UPPERS
GIZA 7
TANGUIS PERUVIAN
EAST AFRICAN
BRAZILIAN PERNAM
BRAZILIAN SAO PAULO
INDIAN No.1 FINE OOMRA

NOTE ON A POLICY OF INTRODUCTION OF NEW VARIETIES OF COTTON IN AFRICA

BY

J. B. HUTCHINSON.

Cotton Research Station, Trinidad.

RECENT reports from several of the African experiment stations show the need for a wider range of material from which to select. This is well recognized, and introduction has been practised on a considerable scale at several stations. Though it should be a function of the geneticist to provide guidance in the choice of new material, unfortunately he has at present little to offer of either theory or experience; some general considerations, however, seem to require emphasis.

Before deciding on the introduction of new material it is most important to decide what kind of improvement is wanted. If asked to specify their needs, most breeders are content to reply that they would be glad of something better in any character. In such cases examination of the records of past successes in relation to the breeding technique in use will probably indicate what characters are likely to give the greatest return for a given expenditure of breeding effort.

Having decided what kinds of improvement are wanted, and what are most likely to be attainable, it is still necessary to consider whether new introductions are likely to provide the most suitable material. The chance of introducing from outside an all-round superior strain diminishes as the adaptation of the local strain to its environment increases. Introduced types are likely to be weakest in characters in which local selection is most severe, such as vigour, resistance to physiological disturbances and, to a less extent, to parasitic diseases. As it is only possible to specify vigour and resistance to physiological disturbance in terms of the local environment, the reaction of foreign types must remain unknown until they are tried. Hence, introduction as a means of improving such characters must remain a gamble, and in most cases selection in local material will offer a better prospect of success.

The chance of obtaining vigorous types by introduction may be increased by a careful study of the climates of areas from which introductions can be made; and where the range of acclimatized

types is small introduction from neighbouring territories is obviously worth a trial. For Africa, also, it is likely that Upland cottons acclimatized in Peninsular India may give vigorous selections. When introducing for vigour, care should be taken to introduce variable material, and to confine selection for a few years to the elimination of the obviously unfit, so as to allow full play to the selective forces of the local environment.

Introduction has the best chance of success where improvement in seed cotton characters is required. Ginning percentage, staple length and fineness are much less subject to environmental influence than are vigour, yield and disease resistance. It also has a limited use where improvement in a single character may be desired, as for instance improvement of boll size in Sea Island by hybridization with Colombian big boll types.

If it be agreed that vigour and adaptability are best obtained by selection in acclimatized material, it follows that introduction will in most cases be only a preliminary to hybridization, and the new variable material for selection will probably be the first or second back-cross to the most vigorous local type. Selection in hybrid material is a long process. At least two seasons must elapse from making the hybrid to the commencement of selection. If the original local strain is still variable, progress by selection in that period will have put it ahead of the hybrid stock. This has been an important reason for the lack of success of Harland's U.4 hybrids. U.4 itself was improved by selection so rapidly that the products of selection in the hybrid material usually failed to compete.

Hybridization should be regarded as a method of providing material for selection when that available locally has been exhausted. In most countries the acclimatized material consists of a variable mixture of types from which selections are made, and which is gradually replaced by pedigree strains. The exhaustion of the variability reservoir is indicated by increasing difficulty experienced in getting superior strains from it. Where there is a possibility of distinct acclimatized mixtures existing in isolated areas, these should be thoroughly explored.

One further means of increasing the variability of breeding stocks without introduction requires attention. The New World species of cotton usually known as *G. punctatum** is naturalized in many parts of Africa. Although it has never been used to produce cotton for export, it has become established and has run wild, and may therefore be supposed to carry genes for vigour and adaptation

* Its proper name is *G. religiosum* L.

to local conditions that would be very valuable in commercial cottons. Though a distinct species, it is of the same group as *G. hirsutum*, and there is no reason to fear the breakdowns and incompatibilities that arise from more distant inter-species crosses. Where vigour is required, such an inter-species cross, back-crossed twice to the Upland parent, should provide valuable material for selection.

If it is decided to select in a hybrid population derived from a cross between a locally adapted and an introduced type, it is not *essential* that the introduced parent should be well adapted to the local environment. It is *desirable* that it should be, as the less the difference between the parents in the characters in which the local type excels, the easier the subsequent selection process. If the reaction of the introduced parent to the local climate is ignored, the hybrid can be made in Trinidad, and either hybrid seed or seed of a back-cross generation introduced without the parent ever being tried. This was the method Harland used with some success.

Exchange of information on introductions already made is highly desirable. Areas which have already provided fairly successful cottons are worth drawing on extensively. Examination of causes of failure may show up certain countries as unsuitable as sources of breeding material. Comparison of material will facilitate exchange between neighbouring territories.

If cotton breeders will send me detailed answers to the following questions I will prepare a summary of the information supplied in order that it may be circulated and made available to all who may be interested, through the medium of the Review:

(*a*) What introductions have been made into the area in recent years? With what success? Where possible give in detail the causes of failure.

(*b*) In what respects could the cottons at present grown be improved? Is improvement possible in the local material? Is any selection in progress in hybrid material?

(*c*) To what extent is the crop of the territory grown from pedigree seed? Are there any established local types with sufficient variability to justify intensive study and selection, or suitable for exchange with neighbouring territories?

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SOME PROBLEMS IN GENETICS, WHOSE SOLUTION WOULD HELP THE PLANT BREEDERS

BY

J. B. HUTCHINSON.

[The following memorandum by Mr. Hutchinson is expected to give rise to an interesting discussion at the Conference on Cotton Growing Problems to be held shortly before this number appears. It is reproduced here for the benefit of those readers who will be unable to attend the Conference, and in the hope that any who care to do so will contribute their views on the subjects of this or of the preceding article in the form of letters to the Editor of the Review.]

A NUMBER of genetic problems still unsolved obstruct the improvement of plant breeding efficiency:

(1) *Problems involving genetic variance.*

Hitherto almost all plant breeding successes with cotton have been secured by selection. Selection, and to a less extent self-fertilization, lead to a progressive reduction in genetic variance until a point is reached when further selection would be a waste of time. How can the plant breeder tell when he has reached that stage ?

(2) *What material will give the greatest response to selection ?*

At the beginning of a breeding scheme considerable improvement is usually attainable by preliminary selection without resorting to line breeding. Later on the possibilities of progress by this means become less, and improvement is attempted by line breeding of selected stocks. Here again increasing genetic purity imposes a limit, and the breeder must either select in the field again or resort to hybridization.

It is suggested that in a new cotton-growing country or where a new and powerful factor is introduced, such as the invasion of a disease or pest, a population with a high genetic variance can be sampled with a reasonable expectation of making rapid progress. Secondary selection, on the other hand, has been successful in producing a steady improvement in performance or differentiation in response to a range of environmental conditions. Unfortunately, no accurate

information is available as to the relative magnitude of environmental and genetic contributions to variance. Probably some genetically variable components of yield, for instance, are sufficiently stable under a range of environmental conditions to justify field selection, though plant yield as a whole is so subject to environmental influence as to be almost useless as an indication of yield per acre of a progeny.

(3) *Seed distribution and the maintenance of purity.*

Is unselected material completely driven out when an improved strain is put into distribution ? How many generations from line breeding is it safe to go in a seed distribution scheme ? The answer must largely depend on local conditions. Long period genetic changes, known as degeneration, are a research problem demanding more attention. Degeneration of the parent strains takes place rapidly when breeding work and seed supply control are relaxed.

(4) *Mixtures* v. *pure strains.*

Recently breeders have begun asking whether purity is really such a highly desirable thing as they had supposed. Studies of crop populations (Hutchinson and Ghose, 1937, Hutchinson, Pugh and others, 1937) have shown that natural selection does not result in the survival of the fittest *type*, but of the fittest *population*, and the fittest population is almost always a mixture of many types. Arising out of the crop population studies an interesting series of competition trials is now being conducted at Indore, and it has become clear that even types that are at a heavy disadvantage in pure culture maintain themselves as permanent constituents of the crop. If a cotton breeder suggests growing a mixture, the technologists rise up in a fury, but it is worth noting in passing that Umri Bani, one of the least variable of the standard Indian cottons in spinning behaviour, is a mixture of about 80 per cent. *G. arboreum* var. *neglectum* forma *indica*, and 20 per cent. of *G. hirsutum* ! Mixtures of *G. arboreum* and *G. hirsutum* have certain advantages in parts of Central India. The Upland constituent improves the quality of the product (*pace* the technologists !) and reduces losses from wilt. Lambert (1937), Nowell (1938) and Mason (1938) have drawn attention to the possible advantages of mixtures over pure strains in meeting a range of environmental conditions. They also have the advantage that unlike plants may compete with each other less severely than like. Examples quoted by Lambert and Nowell are respectively the Pump Scheme and Lecrem strains in the Sudan and Buganda local in Uganda. To these may perhaps be added

the mixture of Tanganyika strains that outyielded all others at Ukiriguru. Many genetic problems arise out of an attempt to use mixtures: a quantitative comparison between mixtures and pure strains is now being attempted at Indore.

The real problem for the plant breeder is how to maintain a desirable mixture. If it is maintained, for example, by annual mixings of strains grown pure on the breeding station, for how many generations can it be safely propagated before replacement? The problem can be attacked by studying the conditions under which stable mixtures maintain their equilibrium. Experiments involving the effects of hybridization, heterosis and segregation are not yet possible, but population studies with such a mixture as the Sudan Pump Scheme strain would probably yield valuable information.

(5) *Hybridization.*

Hybridization is not a substitute for selection, but merely one way of obtaining variable material in which to carry out selection; so long as adequate variability remains in the parent types, it is a waste of time to resort to hybridization. This year's Progress Reports from Experiment Stations show that an increased interest is being taken in hybridization. Some of the Gambia hybrids sent from the St. Vincent Station to Nyasaland have fruited moderately well, but it is suggested that certain of the selected types now available in Trinidad may provide more suitable material for hybridization.

(6) *Acclimatization.*

The orthodox genetic interpretation of acclimatization is that it consists in the isolation by natural selection from a genetically variable population of types in harmony with the new environment. Without genetic variance there can be no acclimatization. Mason has, however, suggested that acclimatization may occur by a progressive moulding of individuals by the environment.

Evidence in favour of the genetic interpretation is provided by the fact that new introductions into Africa of pure pedigreed Upland varieties have met with very little success; Upland types which have succeeded in Africa or Asia have been variable American varieties or reselections from mixtures of varieties.

Linked with acclimatization is "new place effect." With some experience some types of effect can be guessed with some confidence from the behaviour of previous introductions from the same country.

One group of predictable changes are those resulting from change of length of the day.

A more obscure problem is provided by the belief that an introduced strain which does little good in its first year may " settle down " subsequently. Further quantitative experimental records are needed.

In the Uganda Progress Report it is suggested that the variability needed for future breeding work at Serere might be obtained by " the introduction of a large number of diverse types from other countries." What other countries, and what type of diversity? These are questions which the geneticist ought to be able to answer, and the geneticist can't! Further, for how many years will they have to grow any introduced varieties before they can be sure that the " new place effect " is no longer making itself felt, so that it is possible to decide which is best?

(7) *Physiological genetics.*

The volume of Progress Reports suggests a number of border-line problems. For example, timing the planting to avoid the peak of pest incidence opens up considerable scope for studies of plant habit.

The wide distribution of U.4 derivatives renders possible a general study of strain and place interactions, and it is suggested that a complete genealogical tree of U.4 strains should be drawn up. From it an analysis could be made to show which families have proved of greatest utility, either directly or as material for local selection, and it should be possible to discover whether certain groups of strains, or main families, are more suited to some countries than to others. Studies of U.4 derivatives in different places and different years might throw light on Maskell's suggestion that from the results of trials in different places, the behaviour of a group of strains in different seasons might be predicted.

OBSERVATIONS ON THE SELENIZATION OF COTTON UNDER FIELD CONDITIONS IN TRINIDAD

BY

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INTRODUCTION

IN a recent note[5] we reported some experiments on the growth of cotton plants in sand culture to which a nutrient solution containing sodium selenate was added. It was shown that the growth of the cotton plant was unaffected up to concentrations of 20 p.p.m. of selenium, that concentrations of 50 p.p.m. produced severe stunting but did not inhibit flowering and bolling, and that concentrations as low as 10 p.p.m. produced plants with bolls that were strongly toxic to cotton stainers (*Dysdercus howardi,* Ballou). The results with pink bollworm (*Platyedra gossypiella,* Saund.) were less conclusive though considerable mortality was indicated. The selenized plants were found to be in no way repellent to stainers or to pink bollworm. It was suggested that these observations might serve as a basis for a method of controlling these insects. The experiments have now been repeated under field conditions.

PROCEDURE

The soil at the Cotton Research Station is a highly porous loam, and the annual rainfall about 60 inches. The cotton was planted with the coming of the rains in May. The selenium was added in the form of sodium selenate and was applied at the following rates:

Treatment	1	2	3	4
Lbs. selenium per acre	0	4	12	24

Each treatment was replicated three times and the size of the plots was one-hundredth of an acre. The plots were separated by 3 feet of unbroken ground. The selenium was added in solution in small doses over a period of six weeks. The plants receiving the

heaviest applications showed the reddening that we found in sand culture to be characteristic of selenium poisoning, but the growth and setting of bolls were only slightly affected.

Results

A. Stainers (*Dysdercus howardi*, Ballou).—Observations were made on the stainer population of the various plots approximately one month after the first boll had opened. In the control plots (Treatment 1), adults and nymphs of all stages were very plentiful. Treatment 2 also contained many adults and nymphs, but not as many as the controls. Treatments 3 and 4 had no nymphs and only a few adults.

Seed collected from plants receiving the various treatments was fed to stainers of the first instar in the laboratory. Thirty nymphs were used for each treatment. Those fed on control seed all reached adult stage and eggs were laid and hatched (see Table I.). Of the insects fed on seed from Treatment 2, only 7 reached maturity, and these died without ovipositing, although copulation had taken place. In Treatment 3, the insects all died within sixteen days, and in Treatment 4 within twelve days.

This experiment was repeated with 36 nymphs of the first instar for each treatment, using *green bolls* approximately five to six weeks old as the source of food supply (see Table I.). In Treatment 1, 25 of these reached adult stage, oviposition occurred and nymphs were hatched. In Treatment 2, 21 nymphs reached adult stage and again oviposition occurred and nymphs were hatched. In Treatment 3, 31 of the nymphs died within sixteen days and 2 of the remaining 5 reached adult stage, but no oviposition took place. In Treatment 4, all of the nymphs died within sixteen days. It would seem that green bolls are not as toxic as ripe seed grown under the same selenium supply. When younger bolls (approximately two to three weeks) were used, the nymphs did not develop even in the control series (Treatment 1). A comparison of the effects of feeding on seed and green bolls is shown in Table I.

B. Pink Bollworm (*Platyedra gossypiella*, Saund.).—A count of pink bollworm larvæ made by students of the Imperial College of Tropical Agriculture on 100 bolls taken at random from each plot (*i.e.*, 300 bolls per treatment), gave the values which are shown in Table II. It seems clear that selenium can afford considerable protection. The young larvæ are presumably killed before they have time to do serious damage to the boll. It would appear that many of the larvæ had left the control at the time the count was

TABLE I.

EFFECTS OF SELENIZED SEED AND GREEN BOLLS ON GROWTH AND MORTALITY OF COTTON STAINER (*Dysdercus howardi*, Ballou).

		Percentage of Nymphs Reaching Maturity.	*Remarks.*
Seed	Treatment 1	100·0	Eggs laid and hatched.
	„ 2	23·3	No eggs laid.
	„ 3	0·0	Died within 16 days.
	„ 4	0·0	Died within 12 days.
Green bolls ...	Treatment 1	69·4	Eggs laid and hatched.
	„ 2	58·3	Eggs laid and hatched but number only 10 per cent. of Treatment 1.
	„ 3	5·6	No eggs laid.
	„ 4	0·0	Died within 16 days.

made, for the condition of the bolls was much worse than that of Treatment 2.

TABLE II.

NUMBER OF PINK BOLLWORM LARVÆ IN 300 BOLLS

	Total Number of Larvæ.	*Percentage of Dead Larvæ.*
Treatment 1	239	10·5
„ 2	301	17·7
„ 3	126	37·3
„ 4	13	5·7

C. OTHER INSECTS.—When the plants were four to five months old, damage to the leaves by chrysomelid beetles became very marked on certain plots. A count of the number of incisions on the seventh main-axis leaf from the apex (*i.e.*, the first full-sized one) gave the following mean numbers per plot of 50 plants: Treatment 1—956, Treatment 2—1,023, Treatment 3—157, Treatment 4—88.

DISCUSSION

Experiments carried out at the Cotton Research Station, Trinidad, under field conditions, not only confirm those already reported for plants grown in sand culture, but show that cotton plants can be rendered toxic to the cotton stainer (*Dysdercus howardi*,

Ballou) and the pink bollworm (*Platyedra gossypiella*, Saund.) by surprisingly small applications of sodium selenate to the soil. There is one feature of our experiments that calls for special notice. While bolls and seed from the first crop were markedly toxic to stainers and bollworm, it was found that bolls and seed from the second flowering curve after a period of about four months were no longer toxic. It would seem that the sodium selenate is leached from the soil with great rapidity, and this has since been confirmed by actual chemical analysis of the soil. The rapidity with which leaching occurred would of course render the use of sodium selenate somewhat expensive as a means of converting cotton into a living poison bait, for it would apparently be necessary to apply the selenium every year. With heavier soils than our Cotton Station type and under arid and irrigation conditions selenium may not, of course, be removed from the soil so easily, and applications may conceivably be required less frequently. The possibility of using sources of selenium cheaper and less soluble than the selenate has not yet been investigated.

A few comments on the possibility of using selenized cotton for the control of insect pests may not be out of place. The actual experimental procedure would of course have to be worked out for each locality. Very little information is available concerning the behaviour of added selenium under conditions of heavy or moderate rainfall[2,4], while nothing is known concerning its behaviour under arid or irrigation conditions. In general, it will probably be desirable for reasons of expense and safety to plant as small an area as is compatible with successful control. It will also probably be desirable to use the same area permanently (and to wire it !), and not to plant food crops in the vicinity, nor to place the selenium area near to wells. The detection of traces of selenium is fortunately simple,[1] and it should be a routine practice to test neighbouring plants and wells in the vicinity. Soil analyses are of little practical value, for certain types of soil, particularly highly ferruginous ones, may contain large amounts of selenium and yet produce plants containing only traces of selenium at the most.[3] No quantitative relation exists between the selenium content of the soil and that of plants growing on it.

Probably the best results will be obtained by planting the selenium area early, and thus help to clear up the main area before the crop comes in. The seed from the selenium area might be used as a trap after the main crop has been reaped and the plants burnt. The seed might also serve as a source of seed supply for the next

year's main crop as its germination should be good owing to freedom from stainer damage and the absence of pink bollworm (*Platyedra gossypiella*, Saund.) larvæ. It would naturally not be used as stock feed! It should not be lost sight of that certain plants other than cotton may be found more attractive to the insect pests of cotton. The successful application of the method will depend on so many factors that it is quite impossible to generalize. It probably need not be emphasized that responsible scientific supervision and control are essential.

Finally, we have to acknowledge our indebtedness to Dr. A. M. Adamson for his kindness in advising us on matters entomological.

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PLANT SELECTION IN NATIVE COTTON PLOTS

BY

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A LADY who sets her heart on some special style of hat may attempt to make one and risk a succession of failures; or she may make an exhaustive search in a street of milliners until she finds the hat which precisely fills her need. Should she adopt the latter course, it is certain that she will handle a wide range of hats, and, if a discerning person, she will gain a large insight into the millinery art. So it is with the cotton breeder. Either he may set out to create, by continued selection, by hybridization, or by other means, the strain of cotton which fills his needs; or he may search diligently through the crop around him until he finds plants of the right type. The method of search has supplied a number of the world's leading crops, and it is employed as a first step by all plant breeders. Plants obtained in this way are called primary selections. The diligence exerted in the search sets the measure for the success of the primary selections, but there can be few plant breeders who are not impelled to regard primary selections as raw material for continued re-selection. The reliance placed on re-selection, as much recent literature goes to show, is falling into discredit. It is not for me to deny that useful material has been built up by re-selection, still less do I deny that great possibilities are offered by hybridization. Nevertheless, Uganda's best commercial strain, N 17, with nineteen years performance to its credit, is remarkable for its short pedigree.* Starting with this stimulating fact, my present purpose is to stress, as others have recently done, the importance of primary selection.

Uganda, with its wide range of comparatively unselected material, offers a veritable feast of primary selections; but it is still true that the value of the plants chosen depends upon the diligence exerted in the search. One method of feeding raw material to the plant breeding stations is for officers on tour and native employees to gather in seed from outstanding plants. This side line, admittedly

* N 17 was selected in 1919 from N 30, then three years old and itself selected in 1916 from Nyasaland Upland bulk, first introduced into Uganda in 1915.

haphazard, has resulted in a strong seasoning of freaks. Now the freak has its place in any scheme of plant breeding, but it should always be regarded with the eye of suspicion. As an example of this I remember a native, a minor chief of the neighbourhood, bringing me a plant that had set no less than 150 bolls, and that had besides all the desirable features in the text-book. But the gin gave it away; I forget the exact figure: it was about 25 per cent!

The statistics of production and market values from the 1935-36 crop attracted fresh notice to the fact that N 17 was still the best strain in cultivation on a commercial scale. But it was also obvious that the strain had suffered some measure of admixture during its long history. It was therefore decided to make a mass selection from the crop. It is still in general cultivation in Busoga and Lango Districts. So a small plot of N 17 bulk was sown at Serere in 1936, and in the latter part of the same year I visited Busoga and Lango Districts to make selections from native plots. It was decided to keep separate progenies and to bulk them into a mass selection at a later date, and to relegate a few of the best progenies to the Serere breeding plot for re-selection. I mention this to show that we regarded the method employed in making primary selections as common to both ends.

This kind of work has two features which must have been apparent to all who have engaged in similar tasks. The first is the knowledge gained of the cotton plant at home; the second is the knowledge gained of plant types without which all plant breeding is shooting in the dark. The study of cotton in native plots in Uganda soon teaches one that the plant takes on quite a different form from that which is familiar at the plant breeding station. The plant is at home. At the breeding station it is restricted by what, for want of a better name, I call "plantation effect." It is interesting that some such idea was in mind, though experience has shown that the lesson was not fully learnt as early as 1916 and 1920 when Simsa and Serere Stations were laid out.[1] Selection from native plots, when the cotton is intended for native cultivation, therefore removes one of the plant breeder's difficulties. It is no longer necessary to select in the presence of a restraining factor which has no practical application. The inauguration of district variety trials, which approximate very nearly to native conditions, and incidentally often give results very different from those at headquarters, has also helped to overcome this difficulty. Selection from native plots also has the advantage that it is possible to cover a wide range of soils, climates, sowing dates, diseases and pests.

With such a wide range of conditions to explore the knowledge gained of plant types is invaluable. It has been said that plant breeding is an art to which people are born. I believe that it is an art and that it is rightly regarded so. Whether people are born to the art and not made is more doubtful; certain it must be that a thorough knowledge of plant types goes a long way towards successful selection. It has always been my aim to divide up and classify the various types of plant and to associate with each certain characters. That certain of these associations are very arbitrary, especially the classification according to stem colour, I am well aware. Personally, I am content to regard selection as an art and variety testing as an exact science; there is then no danger of confounding the two. In an earlier investigation (the material was the local, unselected cotton of Buganda) I selected out representative plants of a number of types, good and bad, and grew the progenies. We had the satisfaction of learning that the bad types *were* bad, and were that much wiser.

Before going on to review plant types it is necessary to know what characters are required for the success of a strain in Uganda. Commercially Uganda grows one style of cotton, so that these characters tend to hold good for the whole country. The short grass and elephant grass areas, respectively east and west of the Nile, call for somewhat different types of plant; nevertheless the stricter demands of the short grass area can with safety be applied to the whole country. The characters demanded are a $1\frac{3}{16}$-inch staple of silky character, a commercial ginning out-turn of $30\frac{1}{2}$ per cent. at least, resistance to blackarm disease and to a lesser extent to jassids, and, of course, high yield with all that it implies. There are other characters which are desirable, though not absolutely necessary; most of them arrive naturally, however, with a good type of plant, and it is not my purpose to discuss them here. The special call to overcome wilt disease is also excluded from these notes.

My first type has a purple hairy stem. The seed is heavily fuzzed, the lint is the best of the whole series, and many selections have been made from the type. It is, however, also characterized by a straggly habit, marked susceptibility to blackarm disease, and moderate yield. I believe that all these characters are associated with and inherent in the type. Re-selection directed towards the elimination of one or more of the undesirable features always results in the loss of the good type of lint, in further deterioration in yield, habit or reaction to disease. I am convinced that simple re-selection is not capable of raising such a type to a good all-round level of

performance. This is a point of the very first importance and others have made it before me.

"It has been found that the pursuit of any one desirable character, without constant attention to others, quickly renders a strain useless."[2] This maxim, in its context, refers to continued re-selection. The same principle applies with equal force to primary selection.

It may be noted in passing that my first type is, of course, of the very highest value as an element in hybridization. My second type has a green glabrous stem. Its outstanding character is resistance to blackarm disease, other characteristics being low yield and susceptibility to jassid attack. My third type has a bright red glabrous stem, exceptionally long internodes, and is a pronounced shedder. All these types have to be avoided.

My fourth type has a mauve hairy stem, and I consider it to be the most interesting of all. Its characters—habit, resistance to diseases and pests, yield, out-turn and lint—are all good average. I imagine it is the true Nyasaland Upland type of Uganda, and it is interesting to recall that when Nyasaland Upland was first introduced into Uganda the policy of restraint in selecting for lint length advocated by the Liverpool brokers was said to fit in well with the selection of the more robust types of plant.[1] The seed type associated with the mauve hairy stem is normal white fuzzy, and it is again interesting that in those parts of Busoga District which have suffered the least admixture of seed, the proportion of normal white fuzzy seed is greatest.

My fifth and sixth types really belong to the local cotton of Buganda, but they are found as escapes amongst N 17. The fifth type has a brown glabrous stem, is very vegetative, and is the lowest yielder of the series; so its interest is negative only. The sixth type has a pink hairy stem and is pre-eminently a hardy type. Being hairy, it is resistant to jassid attack, and also to blackarm disease. It is a heavy cropper and has a high out-turn of lint, but this is short and harsh. The origin of Mr. Parnell's U. 4 is obscure, but if, indeed, it came originally from Uganda, then its cousins are still to be found here.

Having decided, then, that the majority of selections shall be taken from the mauve stem class, it is necessary to decide on a course of action in selecting amongst them, the object in selecting being not particular brilliance in any one character, but a satisfactory level of all-round performance. A measure of re-selection may serve to fix the type and even to raise slightly the level of performance

by eliminating off types, but there must be no worries on the score of weaknesses. The various characters must, of necessity, be considered singly, so it is necessary to decide upon some order for them. To me the obvious course is to consider them in the same order in which they arise in the ontogeny of the plant. First comes the plant skeleton, on which everything, literally and figuratively, hangs. The plant must be erect, adequate in framework, yet not too large; the monopodia should be few and the sympodia as numerous as is consistent with balanced growth. The fruiting joints on the sympodia should be numerous and not too widely spaced away from the main stem. These are the obvious text-book points. It may sound a high standard to demand, but it must be remembered that with thousands of acres of plants to choose from success is just a matter of patient search. Early maturity, not hitherto considered, need not be laboured as it follows automatically from this type of plant. The plant must be hairy to withstand jassid attack, and absolutely free from blackarm lesions. Even so, accidental escape from blackarm will allow a few susceptible plants to be selected, but these can be discarded when their true nature is displayed in the progeny, which are kept separate, at any rate for one season, for this reason.

The time at which selections are made is of practical importance. It is not usually convenient to stake plants in native plots. For characters mentioned hitherto it is best to select during the grand period of growth, but if ripe seed is to be collected at the same time selection must be put off till the first week or so of picking. Neighbouring plots ripen over a wide range of time, depending on sowing date, so it is easy to move amongst plots which suit one's purpose. Seed can be dried out from green bolls, but knowledge of ginning percentage and lint character has then to be foregone for a year, thus wasting time and trouble. As much ripe cotton as can be gathered is then put away in small bags, or in envelopes, on which concise notes must be written about each selection, or the progeny will lose half their meaning. Returning to headquarters, the hand-gin is put to work, and any selections giving a low out-turn are discarded. I find in practice that very few selections are lost at this stage. Whether it is that the type of plant selected contains a productive factor which ensures a high out-turn, or whether one acquires a field sense for out-turn, I am unable to say. I never attempt to estimate out-turn by handling in the field, except to the extent of discarding a few plants with naked seed. After ginning the lint is handled broker fashion and marked on an alpha, beta,

gamma scale for length, feel and strength combined. Handling in this way saves time on the formal method of measurement, especially if the number of selections is large; it also allows due consideration of the immaturity factor. A fair number of selections are lost at this stage, but I do not attempt to estimate lint quality in the field; I prefer handling after ginning, and also the varying conditions of humidity in the field tend to lead one astray.

A brief note may be added with regard to the after procedure. The first objective should be increase; increase in order to produce a bulk which can be judged in bulk; increase in order to obtain seed for variety tests. For this reason the progenies are not limited to formal rows. If seed is sufficient for several rows of one progeny, well and good; the type can be judged better, and it is easier to discard misjudgments and off-types early on. Moreover, if re-selections are required, it is better to take a few from a large plot than the whole progeny of a limited row. Variety testing can be begun in the second year in a miniature variety trial if seed is still insufficient for a full size trial.

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COMMENTS ON DR. MASON'S NOTE ON THE TECHNIQUE OF COTTON BREEDING

BY

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SIR GEOFFREY EVANS, commenting on Dr. Mason's article on the technique of cotton breeding, in the April number of the Review, says that he suspects that the article was written partly with the object of inviting discussion. The appearance of Dr. Mason's article coincides with a very interesting season here in which rather important differences have been showing up between re-selections within our U.4/64 families, ten years or so after selection was first started within U.4. While we appreciate the gist of Dr. Mason's argument, we cannot resist having a tilt at what we consider some of the rather too generalized views that he expresses.

It is, in actual fact, somewhat difficult to define what is primary and what is secondary selection. If primary selection is interpreted as meaning selection from fairly variable material, and secondary selection from more settled or "refined" material, then we agree that primary selection is much more than half the battle. But after all the point is—does continued re-selection within suitable material give results? With us it has most definitely been doing so. It seems unlikely that the present Gatooma strains could have been obtained quicker by any other method.

Our essential job is to supply the grower with the most profitable strain of cotton as quickly as possible. We have been trying to produce a cotton of reasonable quality which will stand up to the range of conditions in Southern Rhodesia, and which will not crack up in the difficult seasons which are experienced. As a comparatively new cotton-growing country we are still concerned in the main with somewhat crude differences and improvements—a condition that probably still applies to similar work in Southern and Eastern Africa, and probably to many of the other newer areas. (Though Southern Rhodesia has been a small and unimportant cotton producer for the past dozen years or so—at present mainly for economic reasons—adequate facilities have been provided by the successive Southern Rhodesian Governments and the Empire Cotton Growing

Corporation for the cotton-breeding work. Further, cotton is grown scattered over a wide range of soils and climatic conditions, satisfying, partly, Sir Geoffrey Evans' requirement of "a real cotton-growing country.")

We are, as Dr. Mason observes, by continued re-selection trying to improve our cotton by methods essentially similar to those used for the last decade or two, but this we are doing, we trust, with our eyes open. It may be true to say that it is an art we are trying to practise, rather than a science. In actual fact, probably, the impact of the science of genetics on such work as ours has been small. What it has done has been to clarify our ideas concerning the nature and behaviour of our material. As J. B. Hutchinson observed in a letter to one of us: "the plant breeder spends his time dealing with genes in bulk, and the geneticist's greatest contribution to plant breeding will be to provide a reasoned account of the general laws governing the segregation of large numbers of genes of small individual effect."

Where we begin to fall foul of Dr. Mason is with what we consider his rather too generalized views on the value of continued re-selection. He doubts if much improvement in yield is accomplished by such re-selection. After eleven seasons working with U.4 we still find it of much value. Granted we are working in a comparatively new cotton-growing country, and we are exceedingly fortunate in working with a parent stock as complex and as excellent "an omnibus of genes" as U.4; for in the wide range of material which at one time or another has been grown at Gatooma, nothing has approached, let alone been comparable with the U.4 material in general value. Had we been dealing with a more homogeneous original stock, such as the old-established Indian and Egyptian cottons, or nearer home, the more homogeneous Nyasaland Upland, it is possible that our views might have been slightly different. But—an important point—there is, especially in the newer areas, very considerable scope for work with new heterozygous cottons such as U.4.

Dr. Mason observed that the genesis of a great commercial cotton has often been due to a lucky find. Up to a point that probably was so with U.4: we think we are right in saying that at Barberton there has been a very considerable search in Uganda stock for a second U.4, but that nothing approaching it in value has been found.

Having discovered such a primary selection, the obvious course would appear to be to make the fullest use of the favourable material segregating from it. It so happens with us that the cream of our

material comes from a hardy, good opening Gatooma selection from U.4—U.4/64—and today, after ten years' work, all the better strains we are handling are descendants of U.4/64, five and six generations away from this U.4/64 parent—material from known stock which has proved itself reliable and hardy over a period of years and under varying conditions—an important point. We have still, this past season, been getting variations, some favourable and some unfavourable, in the substrains.

The first commercial lots from U.4/64 were such an improvement on the parent material that they were issued, although only moderate for jassid resistance. Heavy jassid damage in the season 1935-36 forced us to search intensively for more resistant material. The difference in the finish of the top crop between highly resistant material and moderately resistant material we are finding, in seasons of moderate attack, to be important. We went back to our commercial stocks, four and five generations away from the original U.4, and to their parent stocks, material of known hardy constitution, good fruiting and opening, to re-select within them plants retaining their hardy, good yielding and good opening qualities, but of a much higher standard of jassid resistance. From results last year and again this year, we think we have been successful. These re-selected lots, in this climatically very difficult year, have yielded very well indeed, up to 1,200 to 1,300 lbs. seed cotton to the acre, a considerable improvement on their parents, which showed a considerable improvement on U.4/64, which in turn, for us, was a considerable improvement on the original U.4 mixed stock.

In the past five seasons we have been undertaking a crossing programme, crossing the best of the U.4/64 material with jassid resistant Cambodia selections, and back-crossing on the U.4/64 material. The main idea has been to get increased jassid resistance while retaining the hardy, good yielding and good opening U.4/64 qualities. Up to the present none of the material segregating from these crosses and back-crosses is at all as happy as the best Gatooma re-selections from the U.4/64 families. The most interesting lots are being carried on, but we have got from the U.4/64 families highly jassid resistant material without losing the U.4/64 qualities.

Several years ago Harland made a number of back-crosses using U.4 as the main parent. All except the (U.4×Cambodia) ×U.4 group were, for Gatooma conditions, obvious misfits from the start, and it is now doubtful whether even in this group the lots being carried on are good enough.

Dr. Mason suggests that it might be advantageous to eliminate

secondary selection completely, and to assess the merits of the progeny of primary selections from some such layout as Harland's Dotted Yield test, or Hutchinson and Panse's Replicated Progeny Row method. Such methods, to us, do not appear highly suitable, and rather in the nature of an academic refinement, at least for the newer cotton countries.

It is our opinion that a first sound judgment of the relative value of strains on a Station—the first stage—can best be formed by growing the "possible" material in fair-sized blocks, and under different soil conditions, over a period of years. The misfits can quickly be discarded. The first assessment is very much a judgment based on eye observation. Assessing the value of material only by "small garden" methods of very small plots and small numbers of plants replicated many times, does not appeal to us. In practice it is difficult to assess the merits of a strain—the hundred and one odd ancillary characters, constitution, response to insect attack, and so on—from a comparatively small number of plants, however replicated. Yield figures and other measures are not enough. Important qualities and defects may not show up in such a layout—a masking of some of the essential attributes of a strain by the surrounding strains.

Some comments of Parnell's at the Cotton Conference in Uganda in November, 1937, appear to us apposite to this note. Slightly paraphrased, he said that there were many people who were not satisfied unless they could work out everything in actual figures and interpret all results by statistical methods. They would only tackle problems if they could see a possibility of a statistical analysis, and he considered that this was becoming rather the tendency in breeding work. He had heard reference to the difficulty in estimating damage, etc., and thought that there was too great a tendency to fight shy of anything that could not be put down in figures and in terms of standard error. Where this could be done it was very desirable, but much useful work could be carried out, and great progress made on problems or under conditions where it was impossible to work with actual figures. At Barberton and at Gatooma, under extremely difficult conditions, breeding work had been carried out which many statisticians would probably think was not worth while doing, but they had produced very satisfactory varieties which were a tremendous advance on the old. By making use of the widest range of material available and judging from what can be seen by eye observation only, it might be possible to go a long way in a comparatively short time. In much of his fundamental and most important work the breeder had to rely very largely on his personal

judgment, and on the goodness of this judgment depended, to a large extent, the value of the strains that would later be tested by figures. At Gatooma, strains are grown each year in four or five different parts of the farm, the amount of land available being such that we are not of necessity restricted to small plots. Any marked restriction of land necessitating the use of very small plots seems, to us, a hampering of cotton breeding work. Including multiplications, sixty to eighty acres are under cotton. By the time a strain is eligible for multiplication, we consider that a fairly true assessment of its local value has been obtained. Each year single plant lots are grown under two different soil conditions. In February-March an assessment of jassid resistance (hairiness) is made and strains below a standard of resistance are discarded. Within the material kept only stock yielding, opening, and finishing well is retained, and only in this is selection made for better lint and ginning qualities. At the stage we have now reached greater use can be made of such methods as Balls' target diagram for obtaining improved lint quality and ginning percentage.

In conclusion, two points. Dr. Mason, in his note, remarks how a cotton is highly resistant to some pest in one country, and quite useless when it is grown elsewhere, and he instances U.4 as being rather susceptible to jassid in the Punjab. Since U.4 is segregating into a large number of types, the majority of which are only mediocre for jassid resistance, may it not be that in the Punjab the more resistant U.4 types have not been thoroughly tested ?

In his note Sir Geoffrey Evans remarks that it is possible that cotton-growing interests in Great Britain have in the past been too wedded to the introduction into the colonies of cotton of the American Upland type; that attempts have been made to establish cotton of this type in areas which are probably not really suited to it; and that failures have been numerous in parts of the Empire. Much nonsense was talked twelve to fourteen years ago about the establishment of cotton in Southern Africa, but when we consider the results that have since been achieved at Barberton, may it not very well be that many of the so-called failures were due to the fact that a sufficiently wide range of Upland material was not introduced and thoroughly tested ?

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THE SPACING OF COTTON IN NYASALAND

BY

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THE spacing of cotton varies in different countries in Africa, but it is not usual, except in Nyasaland, to leave more than two plants per hole, and it is frequently only one. Visitors to Nyasaland have often expressed surprise on seeing the bunches of cotton plants both in native fields and on experiment stations. As the result of a number of experiments, now concluded, it is possible to put this practice on a sounder basis than heretofore.

From time immemorial the usual native method of planting maize has been to wander over the field, jabbing the earth at random with a hoe, and throwing in five or six seeds of maize. In this way the field is more or less covered, and if any gaps appear later they may be filled up with another crop such as beans or pumpkins. The bunches of maize plants which result are seldom thinned, but are left to get on as best they may. When cotton was introduced as a commercial crop the same planting technique—if it can be called such—was employed. The only difference, perhaps because the seed was inedible and issued free, was that more seeds, commonly 15 to 30, were put in each hole. As the result of propaganda by the Department of Agriculture much of the cotton in Nyasaland is now planted in lines, but the practice of leaving a large bunch of plants has proved much more difficult to eradicate.

Sometimes the native will " thin " his cotton field, but this usually means leaving about seven plants in a hole, and it is not uncommon to count many more than this. The reasons for this practice, apart from custom, appear to be: (1) The importance of securing a full stand from the first sowing, as " supplies " never yield as much as the original sowing; and (2) damage, which on occasion can be extensive, to young plants in the field from leaf-cutting ants or other insects. It is for these reasons that a heavy seed rate is advocated in Nyasaland; about 25 lbs. per acre are considered adequate, which allows 20 seeds per hole at 3 feet by

2 feet spacing. Experiments at Domira Bay have failed to detect any difference in yield when cotton is thinned at any time between three and seven weeks after planting. If, therefore, thinning is delayed till six weeks after planting no harm will result, and there should be little danger of loss of stand from the above causes.

It is clear, from observation in the field, that it is wasteful to leave a large bunch of plants in each hole, as many of the plants are stunted and produce no crop whatsoever. It has also been observed that thinning to one plant per hole results in reduced yields, partly due to frequent loss of stand, and partly due to direct reduction of yield even if there is a full stand.

Spacing experiments have been carried out in past years in Nyasaland with no more conclusive result than that it is necessary to have a large number of plants per acre. In 1933 a new series of spacing experiments was begun, using nine spacings and replicated six times in randomized blocks. This has been repeated each year at Domira Bay and less frequently in other parts of the country. Some of the experiments have had to be abandoned owing to locusts or other causes, but there are six which have been harvested. These are: Domira Bay 1933, 1934, 1936 and 1937, Makwapala 1933 (only five blocks were harvested in this experiment), and Port Herald, 1934. The Port Herald experiment was carried out by the Department of Agriculture.

Table I. gives the details of the spacings and the average yield per acre over the whole series, and Table II. is the combined analysis of variance.

TABLE I.

No.	*Intra Row Spacing.*	*No. of Plants per Hole.*	*No. of Plants per Acre.*	*Yield per Acre Lbs. Seed Cotton.*
	Ft.			
A	3	3	14,520	674
B	3	4	19,360	674
C	3	5	24,200	665
D	3	6	29,040	699
E	2	2	14,520	689
F	2	3	21,780	789
G	2	4	29,040	690
H	1	1	14,520	720
I	1	2	29,040	752

In all cases a standard inter-row spacing of 3 feet was used.

TABLE II.

	Degree of Freedom.	*Variance.*	*Observed Value of z.*	*Fisher's Value of z. P=·01.*
Blocks	29	329·9		
Treatment	8	98·2	·5267	·4604
Season	5	8,328·4	2·7467	·5522
Interaction, Season × Treatment ...	40	26·4	·1307	·2913
Error	232	34·26		

In four out of the six experiments spacing No. F (2 feet×3 plants) gave the highest yield, but in none of these were there any statistically significant differences. At Domira Bay in 1934 and 1937 the 1-foot spacings gave the highest yields, but again there were no significant differences. It is interesting to note that in these two years the highest and lowest average yields of cotton for the whole series of experiments were recorded.

Examination of the analysis of variance shows that the factor which has the greatest influence on yield is the season. This is only to be expected in a series of experiments in which there have been wide differences in climate and insect damage. In one year, at least, there was a considerable drought period, in another there was a period of excessive rainfall; some years were comparatively free from insect pest damage, and in others much of the crop was destroyed by bollworm or stainers. In spite of these wide differences there is no significant interaction between season and treatment, so the result should be applicable in good and bad seasons alike.

Though no single experiment showed any significant differences, the combined results pass Fisher's "z" test satisfactorily. The significant difference between treatments expressed in pounds of seed cotton per acre is 68. Thus spacing F is better than any of the others except I (1 foot×2 plants), and the average increase is about 90 lbs. per acre. It is not clear why this particular spacing should give better results, but it appears to strike a balance between overcrowding and insufficient density of plants.

The range of conditions over which these experiments have been made is wide enough for the result to be applied, with some degree of confidence, to all summer crop areas in Nyasaland, with the possible exception of two areas: firstly, the flood and sub-irrigated areas on the Lower River, where a less dense spacing may be advantageous owing to the lush growth of the cotton; and secondly,

the Lilongwe plateau, at present only a potential cotton area, where the shortness of the season makes an early crop essential and a closer spacing may give better results.

As the spacing which has given the highest yield is intermediate in plant density it may be assumed that other spacings not tried would not give such good results. The 1-foot spacings may be ruled out as the extra labour involved would not be worth while without the certainty of higher yields. For practical application the results of this experiment may be summarized as follows: (1) Space the holes 3 feet by 2 feet; (2) use a high seed rate, at least 15 seeds per hole; (3) thin to three plants per hole about six weeks after planting, when danger of the young plants being killed is mostly passed.

Received March, 1938.

THE MYCORRHIZAL RELATIONSHIP IN COTTON PRODUCTION

BY

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In an article* in the issue of this journal of July, 1938, it was suggested that a re-survey of the general agronomy of cotton and a re-examination of the active root system of this crop, including that of the plants grown for green-manuring, should be undertaken. It was also stated that " mycorrhiza is almost certain to prove of importance to cotton, and the great differences observed in Cambodia cotton in India, in yield as well as in the length of the fibre, when grown on (1) garden land (rich in humus), and (2) ordinary unmanured land, might well be explained by this factor."

After this paper was written arrangements were made to have a few samples of the active surface roots of Cambodia cotton sent to London for microscopic examination in order to see whether cotton is a mycorrhiza-former or not. The consignment referred to below was collected on July 21, 1938, by my former colleague Mr. Y. D. Wad of the Institute of Plant Industry, Indore, the junior author of " The Waste Products of Agriculture " (Oxf. Univ. Press, 1931). It consisted of two sets of Cambodia cotton roots (Indore No. 1), each from plants one month old, the first grown on one of the ordinary plots of the Institute, the second on the land of a cultivator of the neighbouring village of Piplia, which was manured with farmyard manure. The first set is representative of land in a fair state of fertility, the second of highly manured land. The specimens were very kindly examined by Dr. M. C. Rayner, the well known authority on mycorrhiza, who reported on the material as follows:

Cambodia Cotton, Indore, Central India

" *Sample* 1 *from Field 7B, Institute of Plant Industry, Indore.*— Surface roots one month old. Roots darkest in colour, in some cases becoming markedly darker, in the regions behind the tips. These

* Howard, Albert, " Insects and Fungi in Agriculture," *The Empire Cotton Growing Review*, vol. xv., No. 3, July, 1938, p. 215.

darker areas coincident with areas of mycorrhizal infection. Infection characteristic, confined to the inner zone of the cortex; large non-septate hyphæ, inter- and intra-cellular in distribution. The cells of the mycorrhizal zone become filled with branched clusters of hyphæ which rapidly undergo digestion, with gradual disappearance of the dense granular contents. Root hairs sparsely produced.

"*Sample 2 from Piplia Village.*—Surface roots one month old from land treated with farmyard manure. Roots similar in appearance to those of sample 1 but *the incidence of infection markedly higher.* Details of infection similar."

The significance of these results to the cotton industry needs no argument. There is now little doubt that cotton is a mycorrhiza-former and that this provision on the part of Nature for the well-being and general nutrition of the crop will have to be taken into account in the future, both in the growing of cotton and also in the research work on this crop.

As regards cotton production, experience in other crops, whose roots show the mycorrhizal relationship, points very clearly to what will be necessary. More attention will have to be paid to the well-tried methods of good farming and to the restoration of soil fertility by means of humus prepared from vegetable *and* animal wastes. An equilibrium between the soil, the plant and the animal can then be established and maintained. On any particular area under cotton, a fairly definite ratio between the number of live stock and the acreage of cotton will be essential. Once this is secured there will be a marked improvement in the yield, in the quality of the fibre and in the general health of the crop. All this is necessary if the mycorrhizal relationship is to act and if Nature's channels of sustenance between the soil and the plant are to function. Any attempt to side-track this mechanism is certain to fail.

The research work on cotton of to-morrow will have to start from a new base line—soil fertility. In the transition between the research of to-day and that of the future, a number of problems now under investigation will either disappear altogether or take on an entirely new complexion. A fertile soil will enable the plant to carry out the synthesis of proteids and carbo-hydrates in the green leaf to perfection. In consequence the toll now taken by fungus, insect and other diseases will at first shrink in volume and then be reduced to its normal insignificance. We shall also hear less about soil erosion in places like Nyasaland where cotton is grown, because a fertile soil will be able to drink in the rainfall and so prevent this trouble at the source.

LONGEVITY OF COTTON SEED DELINTED WITH SULPHURIC ACID

BY

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The knowledge of the longevity of different crop seeds is of considerable importance to farmers. A good stand of crop, essential to successful crop growing, primarily depends upon the viability of the seed. Farmers, for lack of proper information, are often led to believe that seeds become useless for sowing if stored for more than a year or two, and on the other hand it is claimed that some seeds which have remained buried for centuries have successfully germinated. Useful work on the effect of age on the germination capacity of common field crops was done at Poona by Sonavne[1] in 1928 and 1934 and at Lyallpur on the viability of some of the common vegetable seeds by Labh Singh and Sadhi Gambhir Singh[2] in 1935.

Preliminary studies in 1936 by Abdul Hamid and Niaz Mohammed[3] on the germination and yield of delinted cotton seeds showed that the delinted seed gave a better germination and yield. But the cultivators cannot replace the ordinary seed with delinted seed if they have to delint the seeds themselves, as that involves the handling of commercial sulphuric acid, which is difficult and dangerous.

Popular use of delinted seed is possible only if it can be obtained easily in the villages. With this object in view experiments have been conducted during the last two years at Lyallpur Agricultural College to test the viability of the seed, both in the laboratory and in the field, during the sowing and the following season.

Procedure.—Cotton seeds of three varieties commonly grown in the Punjab—viz., Mollisoni, 4F, and 289F—were delinted with commercial sulphuric acid, the time of immersion in the acid varying, being 3, 5, 7, 10, 15 and 20 minutes. The seeds were obtained from the Lyallpur Experimental Farm, and after delinting were dried and kept in envelopes and stored on a shelf in a room side by side, so that all of them might remain under similar conditions. Germination tests were conducted each year both in the laboratory and in the field during May and June, which is the usual time for the sowing of the cotton crop.

In the laboratory weekly germination tests were conducted in Petrie dishes. A measured quantity of clean sand was put in each of the dishes, and with the help of the moulding disc a hundred

holes were made in the sand, and one seed was put in each hole. The seed was covered later on with a measured quantity of sand and equal quantities of water were used for moistening the sand in each dish. Observations were started the day after sowing and continued for four weeks in the year 1934, and for five weeks in the year 1935. Germinations were recorded daily. The results obtained are given in abstract in Table I.

TABLE I.

EFFECT OF DELAYED SOWING ON PERCENTAGE GERMINATION IN PETRIE DISHES.

	In 1934		*In* 1935	
	Average after 0-4 *Weeks.*	*After One Year.*	*Average after* 0-5 *Weeks.*	*After One Year.*
Mollisoni Undelinted ...	82·4	66	55·3	48
4F Undelinted	82·2	65	55·6	49
289F Undelinted ...	50·6	42	52·3	46
Mollisoni				
After treatments of 3, 5 or 7 minutes... ...	83·8	67·6	64·3	55
After treatments of 10, 15 or 20 minutes ...	82·7	68·3	67·6	56

The other two varieties gave similar results.

In the field daily as well as weekly germination tests were made on a small plot of land. Duplicate plots were sown each day and germinations recorded. The results of the weekly germination tests are given in abstract in Table II.

TABLE II.

EFFECT OF DELAYED SOWING ON PERCENTAGE GERMINATION IN THE FIELD.

	In 1934		*In* 1935	
	Average after 0-4 *Weeks.*	*After One Year.*	*Average after* 0-5 *Weeks.*	*After One Year.*
Mollisoni Undelinted ...	58·0	50	40	38
4F Undelinted	48·7	44	37·7	35
289F Undelinted ...	25·0	24	37·1	35
Mollisoni				
After treatments of 3, 5 or 7 minutes... ...	66·3	51·1	44·0	42
After treatments of 10, 15 or 20 minutes ...	63·8	54	45·9	41

The other two strains gave similar results.

Discussion of Results.—Except for a little weekly variation, germination remained more or less the same during the season after delinting of the seed, while the one-year-old seed showed a definite fall in germination. The average germination during the 1934 season in the case of undelinted Mollisoni seed was 82·4 and in that of delinted seed 83·2, while the average of the one-year-old undelinted seed was 66·0 as against 68·0 of the delinted seed. The percentage fall in the year 1934 in case of undelinted seed was 19 per cent., but during the year 1935 the percentage decrease was 13 only. In the case of 4F and 289F there were similar results, 1935 being less marked.

Conclusions

1. Delinted seed can easily be stored over the sowing season.
2. The delinted seed retains its full vitality during the sowing period, which extends over six weeks or so.
3. One-year-old delinted seed shows slight deterioration.

Acknowledgments

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COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

The new season made a bad start again with another huge figure for the American crop in the August Bureau. The acreage estimate on July 8 had shown rather smaller figures than expected, the total planted being only 26,904,000 acres, whereas the Government quota as amended had allowed a possible figure of 28,400,000 acres. The weather reports during the early part of the season had certainly not been altogether favourable, for the Belt from the Mississippi eastwards had had heavy rainfall which threatened a recurrence of bollweevil damage. The general expectation for the Bureau Report was therefore for an average yield of a little over 200 lbs., which would have given a crop of about 11,350,000 bales. But the actual figures went far beyond this with a crop of 11,988,000 bales based on a condition figure of 78 per cent. and an average yield of 217·9 lbs. Both these figures are the highest on recent record, except of course last year, while the par value calculated from them (279·4 lbs.) is a new record.

The September Bureau, however, gave a welcome check to the fear of still larger figures later in the season, with a reduction of the crop to 11,825,000 bales. With a condition of only 65 per cent. the crop would have been still lower but for the fact that the par value was again a new record at 329·4 lbs., making the yield per acre 214·1 lbs. The acreage for harvest was raised to 26,449,000 acres.

There seems to be only one conclusion to be drawn from these figures. Last year's huge crop and yield per acre must now be accepted as not merely an accident or a miracle that will never be repeated, but as indicating a new normal basis of average yield far beyond anything that we have hitherto been accustomed to regard as the best the crop could do. In future it looks as if we must regard 200 lbs. per acre as the minimum, whereas in former years it was about the maximum.

Once more, therefore, we are back in the region of probable Government action, for the Agricultural Adjustment Act of 1938 provided that a Government loan for the 1938 crop is mandatory if

the average price on August 1 of $\frac{7}{8}$ inch Middling Spot cotton on the ten designated markets is below 52 per cent. of the "parity price," or if the August crop estimate is in excess of "a normal year's domestic consumption and exports." It is doubtful whether these conditions were entirely fulfilled, but there is very little doubt that, if the August Bureau proves, as very frequently happens, to be followed by a series of increases, pressure will be brought to bear on the Government to provide another loan for 1938. It may be noted here that the net amount tendered to the Government under the 1937 loan was about 5,300,000 bales net, which, with their holdings under previous loans, brings the Government's total holding up to about 7 million bales out of a total world's carryover at the end of the season, which is likely to be over 13 million bales. With World's Consumption last year running at the rate of not much over 11 million bales there is now quite a probability of a further addition to the carryover during the new season unless consumption revives very materially.

Our second table gives the final details of the Egyptian crop by varieties with the area figures, which are all that is yet available, for the new season. The 1937 crop was, of course, a record by a very long way at 10,814,265 kantars, excluding Scarto, with an average yield of 5·47 kantars per feddan. This year, however, the acreage is down to 1,784,000 feddans, a reduction of 9·8 per cent. Unless last year's record average yield is repeated, which is improbable, the crop is not likely to exceed 9 million kantars. The reduction is mostly in Uppers.

At this stage of the season very little information is available with regard to the Indian crop for the coming season, but our next table gives the final figures of the 1937 crop, which showed a considerable reduction from the record crop of the previous year. The first forecast for the new season covers only certain provinces, but for what it is worth it may be noted that the acreage in these areas shows an increase of 3 per cent.

As promised in July we also give in this issue a new table of the Indian crop by varieties for 1937-38 which summarizes all the details published by the Indian Central Cotton Committee for that crop, and it will be seen from this and the previous table that the percentage of long staple is not quite so high as in the previous season, which was a record.

Our next table gives the details of the World's Carryover of American cotton up to the end of the season, but as the Federation figures of the mill stocks outside the U.S.A. are not yet available

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we cannot complete the season's total. It may be noted, however, that the New Orleans Cotton Exchange estimated the figure at 12,955,000 bales, while Garside's estimate is 13,400,000.

The Federation statistics of the World's Consumption of Cotton with the complete figures for the 1937-38 season will be given in our next issue. The total according to the New Orleans Cotton Exchange was 11,177,000 bales, while Garside's provisional figure was 11,250,000.

The table of the U.S. Consumption which follows shows that in the last three months of the season the figures had once more taken an upward turn, but the season's total made a very poor comparison with that of the previous year.

Before the August Bureau the last two months of the season had shown a very satisfactory recovery in cotton prices from the low point of May. This was partly due to the conditions affecting the crop and the prospect of a moderate Bureau figure, but probably the major cause was the very marked recovery in the New York Stock Exchange during June and July. Early in August, however, that showed signs of being checked and even before the Bureau cotton prices had shown a tendency to relapse, which, of course, was intensified by the unexpectedly large figure of the Bureau. During August, however, all markets were affected by political uncertainties in Europe.

Our last table gives the spot prices of American with other varieties as percentages, and it will be seen that as usual the recovery of American resulted in some cases in a reduction of the percentage figures of other varieties. The season's average spot price of American, however, showed the inevitable reduction from last year's higher figures.

P.S. The Government loan was announced on 27th August. It is based on 8.30 cents for middling $\frac{7}{8}''$, with allowances for grade and staple above or below the basis price.

AMERICAN CROP (EXCLUDING LINTERS).

	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.	1937–38.
Acreage planted (000's)	36,494	40,248	27,860	27,888	30,960	34,471
Acreage harvested ...	35,891	29,383*	26,866	27,335	30,028	34,001
Crop (running bales)...	12,710	12,664	9,472	10,420	12,141	18,252
Yield per acre (lbs.) ...	173·5	212·7	171·6	186·3	197·9	266·9
Season's average spot price (Liverpool—pence per lb.) ...	5·62	6·02	6·93	6·52	7·11	4·97

PROGRESS OF THE SEASON 1938–39.

	August.	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*March.*
Acreage planted ...	26,904	26,904				
Acreage harvested ...	26,347	26,449				
Crop (500 lb. bales) ...	11,988	11,825				
Yield per acre (lbs.)...	217·9	214·1				

* Less 10,396,000 acres special abandonment.

EGYPTIAN AREA AND CROP BY VARIETIES.

(THE CROP ESTIMATES EXCLUDE SCARTO.) 000'S OMITTED.

	1936.			1937.			1938.
	Area: Feddans	*Crop: Kantars*	*Average Yield*	*Area: Feddans*	*Crop: Kantars*	*Average Yield*	*Area: Feddans*
Long Staple:							
Sakel	162	520	3·21	161	558	3·46	138
Maarad	72	289	4·04	81	377	4·67	102
Giza 7	407	1,888	4·64	520	2,466	4·74	573
Sakha 4	42	158	3·78	41	163	3·94	17
Giza 26	—	—	—	2	7	3·97	9
Group Total	683	2,856	4·18	805	3,570	4·44	839
Per Cent. of Total ...	*39·8*	*32·1*	—	*40·7*	*33·0*	—	*47·0*
Medium:							
Fouadi	19	79	4·20	11	54	4·73	10
Giza 12	6	35	6·00	16	86	5·40	39
Giza 3	9	28	3·12	3	14	5·01	2
Others	1	5	3·51	0·3	3	8·80	1
Group Total	35	147	4·20	30	157	5·15	52
Per Cent. of Total ...	*2·0*	*1·6*	—	*1·5*	*1·4*	—	*2·9*
Short:							
Ashmouni and Zagora ...	998	5,901	5·91	1143	7·087	6·2	894
Per Cent. of Total ...	*58·2*	*66·3*	—	*57·8*	*65·5*	—	*50·1*
Grand Total	1,716	8,904	5·19	1,978	10·814	5·47	1,784
Per Cent. Change in Acreage	*+2·8*	—	—	*+15·3*	—	—	*–9·8*
Lower Egypt	1,127	—	—	1,266	—	—	1,209
Upper Egypt	589	—	—	712	—	—	575
Per Cent. of Total ...	*34·3*	—	—	*36·0*	—	—	*32·3*

INDIAN CROP.

(000's *Omitted.*)

	1932–33.	1933–34.	1934–35.	1935–36.	1936–37.	1937–38*
Area (acres)	22,483	24,137	23,972	25,962	25,278	25,583
Crop (Government estimate) 400-lb. bales	4,656	5,108	4,857	5,929	6,317	5,663
Average yield per acre (lbs.)	83	85	81	91	100	89
Staple ⅞ and above (bales)	1,347	1,365	1,255	1,954	2,102	1,775
Per Cent. of Total ...	*28·9*	*26·7*	*25·6*	*30·8*	*33·3*	*31·3*
Staple below ⅞ (bales) ...	3,310	3,743	3,603	3,979	4,205	3,888
Per Cent. of Total ...	*71·1*	*73·3*	*74·4*	*69·2*	*66·7*	*68·7*
Commercial Crop :						
Net exports (bales) ...	2,868	3,406	3,115	3,709	4,267	
Mill consumption ...	2,361	2,336	2,612	2,678	2,631	
Domestic consumption ...	750	750	750	450	450	
Total	5,979	6,492	6,477	6,837	7,348	—
Per cent. on Government estimate	+28·4	+27·1	+33·3	+15·3	+16·3	—
Season's average spot price (Liverpool*—pence per lb.)	4·84	4·52	5·24	5·21	5·29	3·83
Per cent. on American ...	86·1	75·1	75·6	79·9	74·3	77·1
* No. 1 Fine Oomra						

* Excluding Burma.

WORLD'S CARRYOVER OF *AMERICAN* COTTON.

(Running Bales 000's, excluding Linters in U.S.A.)

End of—	*Stock and Afloat.* *U.K.*	*Continent.*	*Orient.*	*U.S.A.* *Mill Stocks.*	*Public Warehouses.*	*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.*	*Elsewhere in U.S.A.**
1932, January ...	506	938	805	1,583	10,019	13,851	1,193	15,044	—
July ...	415	729	695	1,163	6,657	9,659	1,379	12,798	1,760
1933, January ...	620	1,189	852	1,455	9,982	14,098	1,248	15,346	—
July ...	536	1,058	616	1,298	5,703	9,211	1,259	11,550	1,080
1934, January ...	617	1,367	752	1,557	9,469	13,762	1,320	15,082	—
July ...	405	734	590	1,172	5,526	8,427	1,132	10,509	950
1935, January ...	397	640	768	1,148	8,912	11,865	1,060	12,925	—
July ...	201	395	315	749	5,708	7,368	955	9,003	680
1936, January ...	493	614	565	1,405	7,823	10,900	858	11,758	—
July ...	321	359	195	855	3,907	5,637	793	7,005	575
1937, January ...	493	647	460	2,042	6,761	10,403	811	11,214	—
July ...	321	304	350	1,219	2,769	4,963	896	6,259	400
August ...	277	287	277	898	3,466	5,205	—	—	—
September	395	496	230	937	6,892	8,950	—	—	—
October ...	460	700	194	1,368	9,725	12,447	—	—	—
November	648	790	175	1,608	11,513	14,734	—	—	—
December	804	835	161	1,671	11,829	15,300	—	—	—
1938, January ...	870	801	187	1,716	11,733	15,307	984	16,291	—
February	883	785	230	1,769	11,621	15,288	—	—	—
March ...	867	712	201	1,728	10,924	14,432	—	—	—
April ...	865	652	224	1,657	10,444	13,842	—	—	—
May ...	813	595	150	1,542	10,015	13,115	—	—	—
June ...	751	546	91	1,371	9,650	12,409	—	—	—
July ...	708	467	97	1,224	9,593	12,089	—	—	625

* Included in total.

INDIAN CROP BY VARIETIES.

DETAILS PUBLISHED BY INDIAN CENTRAL COTTON COMMITTEE.

Variety.	*Grand Total.*	*$\frac{7}{8}$" and Above.*				*Below $\frac{7}{8}$".*			
		Over 1".	1".	$\frac{7}{8}$"–$\frac{31}{32}$".	*Total.*	$\frac{11}{16}$"–$\frac{27}{32}$"	$\frac{9}{16}$"–$\frac{21}{32}$".	$\frac{17}{32}$" *and Below.*	*Total.*
Punjab	1,514	54	47	590	691	—	—	823	823
Sind	394	—	77	163	240	—	—	154	154
Broach, etc.	388	—	12	139	151	237	—	—	237
Cambodia	225	—	32	193	225	—	—	—	—
Kumpta Dharwar ..	139	—	—	135	135	4	—	—	4
Tinnevelly	134	—	—	134	134	—	—	—	—
Westerns	137	—	—	12	12	55	70	—	125
Northerns	23	—	—	23	23	—	—	—	—
Hyderabad Gaorani..	142	—	—	142	142	—	—	—	
C. P. and Berar ..	711	—	—	22	22	97	592	—	689
Salems	35	—	—	—	—	35	—	—	35
Central India ..	218	—	—	—	—	218	—	—	218
Dholleras	471	—	—	—	—	214	257	—	471
Khandesh	339	—	—	—	—	26	313	—	339
Byapur, etc.. ..	30	—	—	—	—	30	—	—	30
Coconadas	25	—	—	—	—	25	—	—	25
Bengals	294	—	—	—	—	4	—	290	294
Barsi and Nagar ..	38	—	—	—	—	—	38	—	38
Hyderabad Oomras..	351	—	—	—	—	—	351	—	351
Comillas	53	—	—	—	—	—	—	53	53
Others	2	—	—	—	—	—	—	2	2
	5,663	54	168	1,553	1,775	945	1,621	1,322	3,888
Percentage on Grand Total					31·3				68·7

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(RUNNING BALES 000'S: "FOREIGN" IN EQUIVALENT 500-LB. BALES.)

1936-37.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
February ...	664·4	33·6	649·0	1·8	6·2	7·5	63·6
March ...	779·3	33·9	759·8	2·2	7·6	9·7	74·3
April... ...	718·9	32·7	700·7	1·9	7·8	8·6	72·8
May	669·5	32·3	652·9	1·5	6·8	8·3	70·5
June	681·4	31·0	662·1	1·5	6·8	11·0	66·6
July	583·1	27·8	569·8	1·0	5·9	12·4	74·5
*Season's total**	7,950·1	—	7,747·9	20·1	77·9	104·2	818·9
1937-38.							
August ...	604·4	27·5	585·7	0·8	6·4	11·5	72·2
Séptember ...	601·8	27·7	582·8	0·7	6·9	11·4	73·7
October ...	526·5	25·4	511·8	0·7	5·7	8·2	72·9
November ...	484·8	22·6	471·9	0·6	5·1	7·3	57·8
December ...	433·1	20·6	424·7	0·6	4·3	3·5	46·5
January ...	434·7	20·7	424·5	0·4	4·3	5·6	44·9
February ...	427·6	21·6	417·7	0·2	4·1	5·5	47·9
March ...	510·9	22·2	498·3	0·4	5·1	7·1	60·4
April... ...	414·4	20·0	404·4	0·4	4·0	5·7	57·9
May	425 7	19·6	415·2	0·4	3·6	6·5	60·5
June	442·7	20·1	431·8	0·5	4·0	6·5	56·1
July	449·5	22·5	439·9	0·5	3·3	5·8	61·8
Season's total	5756·1	—	5608·6	6·2	56·6	84·7	712·3

* Revised.

HIGHEST AND LOWEST FUTURES PRICES.

1936–37.	*American.* New York. *High.*	New York. *Low.*	Liverpool. *High.*	Liverpool. *Low.*	*Egyptian (Liverpool).* Sakel. *High.*	Sakel. *Low.*	Uppers. *High.*	Uppers. *Low.*
February	12·77	12·36	7·16	6·89	10·15	9·49	8·40	7·83
March ...	*14·70*	12·79	*7·96*	7·18	*12·50*	9·89	*9·73*	8·39
April ...	14·53	12·76	7·94	7·00	12·48	10·60	9·72	8·75
May ...	13·19	12·58	7·33	6·94	11·15	10·36	9·40	8·83
June ...	12·75	11·79	7·14	6·62	9·44*	8·68*	8·48	7·91
July ...	12·58	10·75	6·92	5·93	8·84	7·90	8·42	7·46
1937-38.					Giza 7.			
August ...	*11·01*	9·15	*6·06*	5·28	*7·96*	7·35	*7·57*	6·63
September	9·40	8·15	5·42	4·81	7·63	6·76	6·64	6·00
October ...	8·37	*7·50*	4·84	4·32	6·86	*5·89*	6·08	5·31
November	8·12	*7·50*	4·63	4·34	6·56	6·19	5·73	5·40
December	8·45	7·86	4·83	4·53	6·95	6·39	5·90	5·54
January ...	8·64	8·23	4·91	4·70	7·18	6·82	6·06	5·78
February	9·33	8·48	5·20	4·80	7·43	6·98	6·34	5·84
March ...	9·27	8·48	5·15	4·73	7·25	6·55	6·20	5·77
April ...	9·08	8·44	4·95	4·73	6·90	6·58	5·91	5·73
May ...	8·78	7·67	4·76	*4·10*	6·60	6·04	5·77	*5·04*
June ...	8·83	7·74	4·92	4·21	6·76	6·12	5·85	5·10
July ...	9·11	8·47	5·11	4·73	7·06	6·61	6·15	5·73
1938-39.								
August ...	8·59	8·10	4·77	4·50	6·80	6·50	5·95	5·71

Maximum and minimum each season in italics.
* Quotation changed to Giza 7.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1936–37.	*American (Middling). Pence per lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil.* *Pernam (Fair).*	*Brazil.* *San Paulo (Fair).*	*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
February	7·41	71·0	97·6	92·8	96·2	106·3	130·0	114·3	137·8
March ...	7·95	73·2	98·7	94·3	97·5	106·9	125·8	122·1	159·5
April ...	7·22	74·2	98·6	93·8	97·2	107·6	128·4	128·1	155·1
May ...	7·36	74·3	98·6	93·9	97·3	107·5	127·9	133·0	157·1
June ...	6·95	77·3	98·6	93·5	97·1	107·2	125·9	137·8	144·6
July ...	6·12	75·5	98·0	93·1	97·2	108·7	128·3	142·2	147·9
Season's average	7·11	74·3	98·5	93·7	96·5	106·6	124·3	118·8	152·0
1937-38.									Giza 7.
August ...	5·63	78·2	97·3	92·0	96·4	107·1	130·2	136·4	145·3
September	5·08	75·8	97·0	91·1	98·0	107·9	133·5	132·9	151·2
October ...	4·83	77·0	95·9	90·7	99·0	108·3	142·4	129·0	160·9
November	4·64	81·5	96·8	91·4	100·0	109·7	145·3	128·2	153·7
December	4·84	78·7	96·9	91·7	100·0	109·3	141·3	128·1	153·3
January ...	4·82	77·8	96·9	91·7	100·0	109·3	141·5	125·5	153·9
February	5·21	78·1	97·1	92·3	100·0	108·6	138·4	122·6	149·3
March ...	4·97	75·7	97·0	92·0	99·0	111·1	138·2	120·7	145·7
April ...	4·80	76·7	96·9	91·7	99·0	111·5	139·6	120·2	143·5
May ...	4·46	75·8	96·6	91·0	98·9	112·3	139·2	122·4	152·0
June ...	4·83	74·3	95·9	90·7	96·9	110·4	135·2	122·2	148·0
July ...	4·99	74·5	96·0	91·0	97·0	107·0	134·1	123·4	151·5
Season's average	49·7	77·1	96·8	91·5	98·6	109·3	138·9	127·2	149·3
1938-39.									
August ...	47·4	74·1	95·8	90·5	96·8	107·4	133·8	127·4	155·5

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

567. Report on the Staple Length of the Indian Cotton Crop of the 1936-37 and 1937-38 Seasons. (*Stat. Leaflets No.* 1, 1937, and *No.* 1, 1938. Ind. Cent. Cott. Comm. recently received.) The crops of 1936-37 and 1937-38 are estimated to produce in bales of 400 lb.:

	1936-37.	1937-38.
Long staple, over 1 inch	47,000	54,000
Medium staple, $\frac{7}{8}$ inch to 1 inch ...	2,055,000	1,721,000
Short staple, below $\frac{7}{8}$ inch ...	4,205,000	3,888,000
Grand total	6,307,000	5,663,000

568. Recent Improvements in Indian Cottons. By J. B. Hutchinson. (*Trop. Agriculture,* xv., 4, 1938, p. 83.) An interesting brief review of recent work in connection with the improvement of Indian cottons. The author summarizes the present position as follows: "Reliable cotton up to the standards of its growth, up to sample, and even running, is available in all the growths of the country in greater quantity than ever before. The fundamental legislative measures for its protection have been taken, and are working well, and the responsible elements of the trade are working for better control and a higher standard of trading. Complaints are still made of Indian cotton, and malpractices still exist, but with good cotton readily available, those who have been unfortunate may be recommended to change their suppliers and not their source of supply."

569. Spinning Test Reports on Indian Cottons, 1937-38. By N. Ahmad. (*Tech. Circs. Nos.* 323, 324, 326, 328, 329, 330, 332-5, 337, 1937-38. Ind. Cent. Cott. Comm.) The circulars contain the grader's report and spinning test results for Bengals, Moglai, Khandesh, Berar, Punjab-American, C.P. No. 1, Ujjain, Farm Westerns, and Broach cottons for the 1937-38 season.

570. Technological Reports on Indian Cottons, 1937-38. By N. Ahmad. (*Tech. Circs. Nos.* 325, 327, 331, 336, 338, 1937-38. Ind. Cent. Cott. Comm.) The particulars given include agricultural details, grader's report, fibre particulars, spinning tests, remarks and conclusions.

Verum 262 (*Nagpur*). Area under cultivation about 50,000 acres. Slightly neppy. Suitable for 24's warp.

Late Verum (*Nagpur*). Area under cultivation 16,960 acres. Slightly neppy. Suitable for 33's warp.

Umri Bani. Area under cultivation 840,840 acres. Slightly neppy up to 1928-29, but since then there has been an improvement in this respect. Suitable for 33's warp.

V. 434 (*Akola*). Area under cultivation 43,360 acres. Slightly neppy, but a distinct improvement in the current season. Suitable for 30's warp.

Verum 262 (*Akola*). Area under cultivation 50,000 acres. Slightly neppy. Suitable for 24's warp.

571. Indian Central Cotton Committee. (*Ann. Rpt. to August* 31, 1937, recently received.) The policy of the Committee in actively encouraging the extension of the area under long and medium staple cotton in India has met with considerable success, as will be evidenced by the fact that cotton of staple length $\frac{7}{8}$ inch and above formed 33 per cent. of the total production in 1936-37, compared with 31 per cent. in 1935-36. The year under review saw the inauguration of a scheme for the extension of Jarila cotton, a medium staple wilt-resistant strain, in the whole of the Khandesh tract where at present only the short staple type is grown, and for which the demand is mainly confined to Japan. Work on the improvement of the Dholleras crop was also commenced. The Mungari cotton scheme sanctioned during the year had for its object the improvement of the short staple Mungari cotton in the Northerns and Westerns tract of the Madras Presidency. The various Acts passed for the control, transport, ginning and pressing of cotton functioned satisfactorily. Enquiry into the mixing of Indian cottons was continued, and those responsible for this practice were warned. New markets were established in various districts, and standards were agreed upon for Kumptas, Oomras, Mathias, Broach, and Dholleras cottons. Measures were taken against the importation of bollweevil, red bollworm, and other pests.

In regard to research, funds were provided for 51 research and other schemes, 6 research students were under training, 4 in India and 2 abroad.

The work of the Technological Laboratory continued to progress, and some 431 samples were tested for the cotton industry.

At the Institute of Plant Industry, Indore, progress was made with research on the general botany, physiology, and genetics of Indian cottons, and in addition a number of agricultural investigations connected with the cultivation of cotton and other crops were carried out.

572. A Brief Note on Work of Statistical Interest done at the Cotton Technological Laboratory, Matunga, Bombay. By N. Ahmad. (*Sankhya,* May, 1938, p. 295.) A discussion of various investigations carried out at the Technological Laboratory, the results of which have been published as Technological Bulletins, and abstracts of which have appeared from time to time in the Review.

573. List of Cotton-pressing Factories, with Names of Owners and Particulars of Marks Allotted to them in the different Provinces of British India and Certain Indian States, for the Season 1937-38. (No. 3254. Obtainable: Manager of Publications, Delhi. Price, As. 23 or 1s. 3d.)

574. The Deterioration of Broach Palej Cotton on Storage. By A. N. Gulati. (Conf. of Res. Workers on Cotton in India, 1937. From *Mnthly. Bull. of Agr. Sci. and Practice,* Rome, April, 1938, 162T.) Fungi are largely responsible for the deterioration of Broach Palej cotton, the moisture and heat of Bombay in the monsoon season conducing to the growth of fungi. The stained and matted parts of lint were more severely attacked by micro-organisms than clean lint. Further study is necessary of the decomposing powers of the eighteen distinct species of fungi found.

575. Some Effects of X-rays on Uppam and Karunganni Cottons. By V. Ramanatha Ayyar and R. Balasubramania. (Conf. of Res. Workers on Cotton in India, 1937. From *Mnthly. Bull. of Agr. Sci. and Practice,* Rome, April, 1938, 165T.) Pollen grains of two strains of *Gossypium herbaceum* and dry seeds of two strains of *G. herbaceum* and one strain of *G. indicum* cottons were exposed to X-rays for different periods with a view to producing progressive

mutants useful for breeding. High dosages lowered the viability of the seeds. When treated pollen was used plant growth was found to be stimulated in the succeeding generations. No differences in morphological characters were observed. By exposing dry seeds to X-rays three new types of mutants—two chlorophyll deficients and one meristic variant—were obtained in the second generation. These were recessive in genetic behaviour and were of no use economically.

576. SCIENCE AND PRACTICE OF AGRICULTURE IN INDIA. By B. Viswanath. (*Agr. and Livestock in India*, viii., 1, 1938, p. 9.) A discussion of the soils of India, soil cultivation, fertilizers and manures, the problem of organic matter and manure supply, and the problems of food and nutrition. The view is expressed that research should concern itself more with details of existing practices than with the evolution of wholly new methods, and should aim at building up on the existing system a state of agriculture to suit the condition of the soil and the resources of the cultivator.

577. BENGAL: *Cotton Growing Experiment.* (*Text. Wkly.*, 10/6/38, p. 782.) It is stated that an interesting experiment has been started to grow long staple cotton in Bengal, and a Committee known as the Bengal Cotton Committee has been formed for the purpose. The Bengal Millowners' Association and the Government of Bengal are to make equal contributions to carry out the experiment. The prospects of success are said to be good. Bengal now has a cotton mill industry of its own, which is expected to grow rapidly and consume all the cotton that may be grown. Recent investigations carried out by the Industries Department have shown that the scope for the development of the cotton mill industry in Bengal is very great, as the consumption of cotton goods imported into the province from other provinces and from foreign countries amounts to nearly Rs. 14 crores in value. Labour and climatic conditions are also favourable. If the experiment succeeds Bengal mills will have cotton at hand, which they have now to import from other provinces or overseas.

578. HYDERABAD: *Spinning Tests with New Strains of Hyderabad Gaorani* (*Gossypium indicum*, Lamk.). By K. Sawnhey. (Conf. of Res. Workers on Cotton in India, 1937. From *Mnthly. Bull. of Agr. Sci. and Practice*, Rome, April, 1938, 162T.) From a study of the data presented it will be seen that although there is considerable variation in spinning performance, the new strains Hyderabad Gaorani, Gaorani 4 and Gaorani 6 continue to retain their superiority over local Gaorani in most of the districts.

579. MADRAS: *Cotton Industry*, 1937-38. (*Madras Agr. J.*, May, 1938, p. 186.) The area planted to cotton is estimated at 2,556,100 acres, compared with 2,578,400 acres in the previous season. The yield is expected to reach 505,200 bales.

580. MYSORE: *Cotton as a New Crop in the Irwin Canal Tract.* (*Mysore Agr. Calendar*, 1938.) Two varieties of cotton have been found suitable for the tract, M.A. 11 and Co. 2. An area of 130 acres has been planted, and the crop is under observation.

581. PUNJAB: *Cotton Cultivation*, 1936-37. (*Rpt. of Operns. of Dpt. of Agr.*, 1937.) The area planted to cotton constituted a record at 2,909,152 acres, of which 1,361,042 acres were sown with Punjab-American varieties and 1,548,110 acres with desi cotton. A considerable area was planted with 43F and Mollisoni 39 cottons. The former commands a high premium in the Bombay market, where mill opinion is that it is the best cotton grown in India. The Mollisoni 39 has done so well that it is now recommended as the only desi cotton

for the canal colonies. The new Jubilee cotton—a cross between Mollisoni and the Chinese cotton Million-Dollar—was under trial and gave very promising results. Very promising results have also been obtained in the Multan district with the variety Sanguineum 119, which has the high ginning outturn of 37·5 per cent.

Varietal, irrigation, and time of sowing experiments were continued during the year.

The chief pests and diseases encountered were white-fly, pink bollworm, spotted bollworm, and root rot disease.

582. INDIA. By Sir William Himbury. (British Cott. Growg. Asscn., 1938. Price 1s.) A very interesting account of a visit to India, dealing specially with cotton growing in Sind and in the Punjab. Satisfactory work is being carried out by the B.C.G.A. (Punjab), Ltd., in connection with cotton and wheat. Sir William is well pleased with the agricultural work going on in India, which he feels is of a permanent character and appreciated by the people.

583. BREEDING OF IMPORTED STRAINS OF COTTON SUITED TO LOCAL CONDITIONS, WITH SPECIAL REFERENCE TO SIND, AND THEIR EXTENSION. By K. I. Thadani. (Conf. of Res. Workers on Cotton in India, 1937. From *Mnthly. Bull. of Agr. Sci. and Practice*, Rome, April, 1938, 164T.) The subject is treated under the following headings: Early attempts at introduction of high quality cottons in Sind: breeding of improved Sind desi cottons for pre-Barrage conditions; breeding of improved cottons for post-Barrage conditions; improved Sind-American cottons, Sind 4F-98, and Sind Sudhar (289F-1) cottons; improved Sind Egyptian and Sea Island cottons; study of hereditary characters.

584. MICRO-CLIMATOLOGY OF IRRIGATED COTTON FIELD IN SIND. By B. M. Dabral and S. S. Chiney. (*Ind. J. Agr. Sci.*, viii., 2, 1938, p. 161.) Data on temperatures and relative humidities are recorded on a cotton crop under irrigated and unirrigated conditions at three typical heights above ground in the Sakrand district, Sind. When the crop is young irrigation reduces temperatures and increases humidity over the cropped bed. During the later stages of growth the differences between the two environments are great. Temperatures are highest at 6 inches above ground on a barren plot, and decrease as the height is increased up to 3 or 4 feet. Under cropped conditions the results are reversed. Soil temperatures show wider differences; uncropped open beds show about 8°-10° C. higher temperatures than cropped ones for a few days after irrigation, and the temperatures run closer as the soil gets drier in all phases of growth. The lowest soil temperatures are reached after a few days of irrigation. Instruments at 4 feet from the ground, as in the Stevenson Screen, do not show the conditions inside a crop.

585. THE SALINE SOILS OF SIND AND THE COTTON PLANT. By M. A. S. Iyengar. (Conf. of Res. Workers on Cotton in India, 1937. From *Madras Agr. J.*, July, 1937, p. 201.) Refers to the tolerance of cotton to salinity, and suggests the possibility of utilizing cotton for removing sodium salts since it removes as much as 126 lb. of sodium chloride per acre. The need is further pointed out of growing cotton instead of keeping the land fallow after the soil has been leached with water. It is stated that the desi selection 27 W.N. and the American selection $285F_2$ are tolerant to salt.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

586. The following reports have recently been received:
BRITISH COTTON GROWING ASSOCIATION: Ann. Rpt., 1937.

East Malling Research Station: Ann. Rpt. for 1937.
Rpt. of the Agricultural Research Council, 1935-37.
Southern Rhodesia: Rpt. of Sec. of Dpt. of Agr. and Lands, 1937.
Sudan: Rpt. of Govt. Chemist, 1937.

587. Empire Cotton: Production and Spinning Quality. By Sir Wm. Himbury. (*Text. Mercury and Argus, Ann. Trade Rev.*, 1938, p. 12. From *J. Text. Inst.*, xxix., **4**, 1938, A203.) A review of progress in the production of Empire cottons. A table shows the lint characteristics of cotton from Uganda, Tanganyika, Nyasaland, Nigeria, the Sudan, and the Punjab, with counts for which they are suitable.

588. British Cotton Growing Association. The thirty-third Annual Report for the year ended December 31, 1937, contains much useful information on the Association's work in India and in other parts of the Empire. Details are given of the work of the B.C.G.A. (Punjab), Ltd. Sections devoted to individual countries follow, and attention is drawn to the record crops of Uganda and the Anglo-Egyptian Sudan. Taking a long view of all the Empire cotton-growing areas, and ignoring seasonal setbacks common to all, and the stationary output of some centres, there appears every reason to suppose that the tendency on the whole is towards still greater production. A continuance of the lower range values ruling at the end of the year is probable for some time to come, and may cause a temporary check in some countries, but cotton growing as an economic factor in the welfare of the people is so firmly established that any actual abandonment is out of the question.

589. ASIA. Ceylon: *Cotton Industry*, 1936-37. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.*, 1936-37.) In last year's report it was mentioned that interest in cotton had increased somewhat among native growers, in response to propaganda by the Agricultural Department. The crop of 362 bales was an increase over that of the previous year, but fell short of expectations owing to bad weather. The Government's purchase scheme found favour with producers, who received cash on the day of sale.

The Agricultural Department have been carrying out preliminary manurial trials on two very different soil types, and the results show that the higher yields following the application of sulphate of ammonia or of farmyard manure make manuring a paying proposition at the current prices of manure and of cotton. Further trials are required to determine the best quantities of manure to use and the times of application.

590. Cyprus: *Cotton Industry*, 1936-37. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.*, 1936-37.) The work on the improvement of the island's cotton crop was continued, and at the Experiment Station cultural, time-of-planting, spacing, fertilizer, and irrigation experiments were carried out. Mesowhite is the chief variety cultivated, but in a variety trial at the Station, the Egyptian strain, Giza II, gave a higher yield. The yield of cotton for the season was greater than in the previous year, though the acreage was somewhat smaller; the average yield per acre was 454 lb. seed cotton, the highest for the past five years. A law was passed to regulate cotton cultivation, the main objects being to control the type and supply of seed for sowing purposes and to license ginneries.

591. AFRICA. Gold Coast: *Cotton Cultivation*, 1936-37. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.*, 1936-37.) In Togoland farmers are giving up cotton growing owing to the low prices prevailing. On the small area still cultivated yields show an improvement on those of the previous season. The crop is exported into French territory where the only ginnery in the vicinity is situated that is capable of dealing with the crop. The cotton supplied to growers on request by the

Experimental Station is an improved Ishan type. In the Northern Territories yields were higher than in the previous season. All the cotton grown is used in the country.

592. GOLD COAST: AGRICULTURE IN NORTH MAMBRUSI. By C. W. Lynn. (*Bull. No.* 34, Dpt. of Agr. Gold Coast, 1937.) The first part contains a description of the indigenous system of agriculture and the survey methods followed in studying it; in the second part various experiments are discussed under the headings: rotations, cultivation, manuring, root crops, and miscellaneous trials.

[*Cf.* Abstr. **583**, Vol. XIV. of this Review.]

593. NIGERIA: *Cotton Cultivation*, 1937-38. (*Half-yearly Rpt. of Dpt. of Agr. to March* 31, 1938.) *Northern Provinces.* Weather conditions in general were favourable. The total rainfall for the year was below the average, but this was due mainly to the very low rainfall from April to June. The shortage during these months only affected the cotton crop indirectly by delaying the planting of food crops, which in turn delayed the planting of cotton. The further decrease in purchases for the season is attributed to the low prices ruling. All reports indicate that a much larger proportion of the crop than usual was absorbed by the local weaving industry or exported to French territory. It is fortunate for cotton growing in Northern Nigeria that the local weaving industry competes so actively for the crop, for although it reduces the quantity of cotton available for export, it also keeps the growing of cotton going at times like the present when world prices are extremely low, and enables rapid expansion to take place when world conditions improve. The set-back in the Bauchi Province at a time when steady development seemed likely is unfortunate, but in view of the fact that many parts of the Province are particularly well suited to cotton growing it is to be anticipated that progress will again take place when there is some improvement in prices. Unusually high yields were obtained at the Farm centre at Bauchi this season.

At the main markets 0·6d. per lb. was the opening price for cotton, but this rose to 0·7d. in December, and to 0·8d. early in January, at which figure it remained until the end of the season. In all 108 markets were gazetted for the purchase of cotton. The general impression is that the low prices ruling have not appreciably affected the demand for seed for planting the new crop.

Southern Provinces. In spite of unusually dry weather conditions during the growing season yields seem to be about average. It is expected that the final crop will approximate to that of last season, namely 6,000 bales.

594. *Soil Experiments in Nigeria.* (*Bull. Imp. Inst.*, xxxvi., 2, 1938, p. 220.) The following statement is furnished by H. C. Doyne, Senior Chemist, in the half-yearly report of the Chemical Section, Ibadan, Southern Provinces, July-December, 1937.

An attempt has been made to find out the changes which occur in a soil which is kept entirely free from growth of any sort and which is cultivated weekly. Three plots have been in existence since June, 1934, and composite samples are taken from each to a depth of 6 inches every month. After three years it was found that there was an average loss of 43 per cent. of total nitrogen (initially 0·046 per cent.) and 39 per cent. of total exchangeable bases (initially 3·38 Mit. Equivs. per cent.). The carbon-nitrogen ratio had increased by 3 per cent. (11·5 to 11·9), and the pH value had dropped from 6·6-6·3 to 6·3-5·9. There was no apparent change in available phosphorus content. The plots were on poor sandy soil on which the surrounding vegetation is spear-grass. Owing to the level nature of the ground and the small size of the plots, erosion is unlikely to have occurred, and the silt with clay content had not diminished two years after the experiment had started. The experiment is being continued.

595. NYASALAND: *Crop Prospects*, 1937-38. A recent report from H.M. Eastern African Dependencies Trade and Information Office states that in the Lower River areas 1,286 tons of cotton seed were issued in March, in the Blantyre and Central Shire districts 100 tons and in North Nyasa 11 tons. Growth is generally satisfactory. Bollworm has made its appearance, but in small numbers only, and if the infestation does not develop considerably, the prospects for the crop may be regarded as promising.

596. *Colonial Development Water Supply Investigation in Nyasaland.* (*Progress Rpt. No.* 7, 1937.) A report upon the important work being carried on by the Government. A new group of wells, extending over an area measuring 12 miles from north to south and 10 miles from west to east, forms a northerly continuation of the group constructed in the Salima-Domira Bay area in 1932. The conditions of the bore-holes and wells of the Domira Bay area were inspected, and found to be generally satisfactory.

597. SOUTHERN RHODESIA: *Cotton Industry*, 1936-37. (*Rpt. of Secy. Dept. of Agr. and Lands*, 1937.) From the report of Major G. S. Cameron, Cotton Specialist of the Corporation, we learn that the season opened well with early planting rains. Despite a drought period in February and March, cotton yields on the whole were very satisfactory. On the Cotton Station, Gatooma, the season was the best since the Station started. Strain bulks, under more or less commercial conditions, were averaging around 1,000 lb. seed cotton to the acre. During the year the Cotton Pest Prevention Act became law. It prohibits the practice of ratooning cotton plants, and of allowing them to stand from one growing season to the next. This is a very important measure to the cotton industry, and will probably have the effect not only of preventing the spread of Sudan bollworm, but in most areas of reducing it to the position of a minor pest. The main damage to annual cotton, as a result of the ratooning practised, was, however, caused by stainers. The important immediate effect of the close period, therefore, will be to reduce such part of the stainer damage as was primarily due to ratooning and stand-over cotton. At the Bindura Ginnery the percentage of good colour cotton was less than usual, and a large proportion of the native cotton handled was spotted; this, however, can in large measure be attributed to ratooned crops in the areas concerned. Injury from American bollworm was comparatively slight, Dolichos beans were found very attractive for egg-laying; jassid attack was also mild, but the breeding of strains resistant to it was continued. Several new strains were derived from U4/64. An interesting feature of the year's work was the increased cotton yields obtained following applications of Indore compost at the rate of 5-10 tons per acre, and during the drought period the composted areas suffered considerably less than the adjoining non-composted areas. More of the natives are taking an interest in cotton cultivation.

598. THE PROMISE OF COTTON IN SOUTHERN RHODESIA. By G. S. Cameron. (*East Africa and Rhodesia*, 9/6/38, p. 1166.) Describing the history of cotton in the Colony, when at first Improved Bancroft was cultivated, only to fall a victim to jassid, the author goes on to show how Parnell's discovery of U. 4 saved the situation, and now a lot of derivatives of this strain are under trial at the Gatooma Experiment Station, where also much work in connection with insect pest control is being carried on. A Cotton Research and Industry Board is now at work, and it is hoped to get the natives once more to take up the industry, since besides paying a reasonable return the crop forms a valuable member of a rotation. Tribute is paid to the successive Governments of Southern Rhodesia which have given strong support to the work of the Corporation. Difficulties

have been encountered and overcome in the past, and there is little doubt those now being tackled will be surmounted. When they are, the credit will be due not so much to either body or organization by itself, but to the whole-hearted and cordial manner in which each has co-operated with the other.

599. South Africa: *Cotton Industry,* 1936-37. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.,* 1936-37, issued 1938.) Weather conditions generally were not good and lower yields than anticipated were obtained. In the low veld, however, in the Barberton area, high yields were obtained by farmers ranging from 860 to over 1,000 lb. of seed cotton to the acre on 100-acre blocks; on old tobacco lands yields as high as 1,600 lb. per acre were obtained. At the Barberton Station selection work was continued for strains combining high yields with jassid resistance. Good progress was made in connection with the insect pest control work, which is closely co-ordinated with that being carried out in Swaziland and in Natal under the general direction of the Barberton Station.

Work has also been carried out on the maintenance and improvement of soil fertility. Erosion has been guarded against so far as possible by means of open drains and contour banking. In addition, investigations on the best rotation crops to use with cotton form an important part of the work, together with experiments on the utilization of waste products through composting.

The experiments at the Magut Station were destroyed last season, partly by excessive rain and partly by insect pests. Stainers, which caused a great deal of damage, were directly traced to breeding grounds in ratooned and standover cotton in the district, and this fact, together with the results of other experiments carried out at the Station on stainers, has led to strong support being given by farmers to proposals for legislation forbidding the practice of ratooning.

600. Swaziland: *Cotton Prospects,* 1937-38. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.,* 1936-37.) The acreage under cotton was small on account of low prices received the previous season, and the lateness of suitable planting rains. The Government and the staff of the Corporation are making special efforts in the southern part of the country to encourage cotton cultivation, and as improved strains from the Corporation's Station find their way into general cultivation, and some improvement takes place in native cultural methods, cotton growing should show a development. In addition, it is proposed to start native smallholdings on the lines on which similar work has been begun in other parts of Africa, but adapted to local conditions.

601. Tanganyika: *Cotton Prospects,* 1937-38. A recent report from the Dept. of Agriculture states that in Mwanza, Lake Province, cotton promises good yields, but from reduced acreage. In the Northern Province cotton is doing well, but here also the acreage has decreased. Prospects for cotton are generally good in Tanga Province, and also in the Eastern Province. In the Southern Province cotton is doing well at Lindi, though it is in need of rain, but in Tunduru and Mikindani prospects are poor.

602. Uganda: *Cotton Prospects,* 1938-39. A recent report from the Dept. of Agriculture states that the planting of food crops is normally completed by the end of April, but this season planting was still in progress at the end of May on account of the drought which extended to the latter half of April. Consequently, though weather conditions were favourable for cotton planting during May, except in parts of the Northern Province, the acreage actually sown was smaller than normal, being only one-third of that planted during the corresponding month of last season when conditions were, however, exceptionally favourable.

603. AUSTRALASIA. Queensland: *Cotton Prospects,* 1937-38. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.,* 1936-37.) Applications were received for seed to

plant about 70,000 acres. In most districts the weather at the beginning of the season was favourable, but high temperatures and little rain in February caused extensive shedding of squares and young bolls, and the condition of the crop in March was disappointing.

604. WEST INDIES. SEA ISLAND COTTON. (*W. Ind. Comm. Circ.*, 30/6/38, p. 256.) It was reported at a meeting of the Advisory Committee of the West Indian Sea Island Cotton Association held in London in June, that the Association's stand at the Empire Exhibition, Glasgow, was attracting much favourable comment and stimulating interest in the use of garments made from Sea Island cotton. Numerous enquiries had been received from visitors as to where the goods may be purchased, and overseas business men had been supplied with patterns to enable them to develop a trade in Sea Island goods when they returned home.

605. LE COTONNIER SAUVAGE (?) DE MARIE-GALANTE. By A. Chevalier. (*Rev. Bot. Appl.*, **18**, 1938, p. 115. From *Pl. Bre. Absts.*, viii., **4**, 1938, p. 375.) An examination of plants and herbarium material of the species described by Watt as *Gossypium Marie-Galante* shewed such close resemblance to *G. barbadense* L. var. *maritima* Watt that it is regarded as a special race and named *G. barbadense* L. var. *Marie Galante* (Watt) A. Chev.

606. MEMORANDUM ON THE PRODUCTION OF PEDIGREE SEED OF MONTSERRAT SEA ISLAND COTTON. By J. B. Hutchinson. (*Rpt. 2nd Ord. Gen. Mtg. W. Ind. Sea Is. Cott. Asscn.*, Antigua, 1937, p. 20.) It is proposed that all the cotton growing islands of the Leeward Islands should adopt the Montserrat Sea Island strain, and that all breeding work on the strain should be concentrated in Montserrat. A scheme for the multiplication of selected strains is described.

607. THE ANTIGUA SEA ISLAND COTTON INDUSTRY. By F. H. S. Warneford (*Rpt. of the 2nd Ord. Gen. Mtg. of W. Ind. Sea Is. Cott. Asscn.*, 1937, p. 21.) An account of cotton growing in the island since its inception in 1901. Early years were marked by rapid expansion, but the appearance in 1907 of the flower-bud maggot caused a marked decrease in cultivation during the following two years. In subsequent years the acreage planted was mainly determined by the price ruling for cotton. The chief pests encountered are pink bollworm, cotton worm, and stainers. The cotton seed planted is obtained from Montserrat. In 1916 the Antigua Cotton Growers' Association was formed, its chief function being to ensure to the small grower a fair market for his produce—seed cotton being purchased at a price based on the current market value, and the grower receiving 75 per cent. of the net profits made on sale of the lint. Since 1933-34 there has been a steady increase in cotton cultivation in Antigua as a result of the improved demand effected by the activities, of the West Indian Sea Island Cotton Association, and a ginnery has been opened in St. John's.

608. SEA ISLAND COTTON IN BARBADOS. (*W. Ind. Comm. Circ.*, 16/6/38, p. 240.) At a meeting of the Barbados Cotton Growers' Association in May, Mr. R. W. Tucker, Entomologist of the Dept. of Agriculture, stated that cotton growing can pay in Barbados; that the cost of all stages to marketing leaves a paying margin with even a mediocre crop; that attention to spraying and dusting is essential, but that with the information available protection against insect pests is practicable and economic.

609. NEVIS COTTON REGULATIONS. (*W. Ind. Comm. Circ.*, 5/5/1938, p. 176.) Regulations dated March 28 provide that all seed cotton shall be delivered to ginneries by June 30 and ginned by July 31. All cotton seed at ginneries shall be fumigated daily, and no cotton seed shall be removed except under authority

for shipment for oil extraction, or planting, or after it has been crushed. All bags and packages used for transport of seed cotton must be boiled or burnt, and ginneries cleaned of all cotton refuse before August 31.

610. St. Vincent: *Cotton Crop*, 1937-38. (*W. Ind. Comm. Circ.*, 19/5/38, p. 200.) The crop was one of the best on record from the point of view of yield, and was little damaged by pests and diseases. The ginning percentage averaged 25 per cent. Some 160 bales shipped early in the year sold at a price of 2s. per lb., and encouraged by this further large shipments were made by growers.

611. Sea Island Cotton Industry in St. Vincent. (*W. Ind. Comm. Circ.*, 16/6/38, p. 241.) The close season has been fixed from May 1 to August 15. Arrangements have been made for the rigid enforcement of the close season regulations, and the number of inspectors has been increased to enable a more thorough examination of the cotton fields to be performed at an earlier date. Some 80,000 lb. of special seed from the commercial multiplication fields have been reserved for sowing the 1938-39 crop; should, however, the price of St. Vincent Sea Island not be maintained at the 1937-38 level, there will probably be a reduction in the area planted.

612. Progress Report on the Sea Island Cotton Breeding Work at the Cotton Experiment Station, St. Vincent, 1936-37. By S. H. Evelyn. (*Rpt. of the 2nd Ord. Gen. Mtg. of W. Ind. Sea Is. Cott. Asscn.*, 1937, p. 23.) The season 1936-37 was the worst experienced in the last seven years. In the early part alternate periods of drought and heavy rains did much to inhibit even and continuous growth of the plants, and a very wet January favoured fungus diseases, pink bollworm damage, and shedding to such an extent that in some of the experiments the estimated loss of material was as high as 70 to 80 per cent. It is of interest to report that even under such conditions the commercial lint received excellent reports from the spinners and brokers. Data are given on strains selected from V. 135 for high weight of lint per seed and high ginning outturn, on the Red Sea Island strains—the lint length of which, 57-60 mm., is now considered a stable character—and on the V. 135 Montserrat hybrids. Selection within the last series of hybrids was based on the three lint lengths, 57 mm. and over, 53-55 mm. and 50-52 mm. The first back-cross (Gambia × V. 135) × V. 135 was obtained this season. The Gambia parent is a very prolific sympodial Bourbon which, under St. Vincent conditions, has shown high resistance to the common fungoid and bacterial cotton diseases. The F_1 plants were not affected in spite of the favourable conditions for the spread of diseases, and the material appears very promising. The work on back-crosses between V. 135 and the wild species *G. aridum*, *G. tribolum* and *G. armourianum* was continued, but in future the work will be carried out at the Trinidad Station where greater facilities exist for studying these hybrids. Progenies were examined of the commercial Sea Island cottons of Barbados, Montserrat and Nevis in which naked seeds had been discovered. Genetic experiments with Sea Island strains were continued, but the results are not yet conclusive.

COTTON IN THE UNITED STATES.

613. Some Notes on the Origin of Cotton Varieties in the United States. By J. O. Ware. (*Proc. 37th Ann. Convent. Ass. S. Agr. Wkrs.*, Jackson, Miss., 1936, (1937), p. 55. From *Pl. Bre. Absts.*, viii., 4, 1938, p. 376.) The varieties of cotton in the U.S.A. may be divided into three groups: Sea Island, Upland, and American-Egyptian. The history of the introduction of these three types into the States and the origin of the present varieties by breeding and selection are traced.

614. THE FUTURE OF THE U.S. COTTON-GROWING INDUSTRY. By W. Witmor. (*Int. Cott. Bull.*, xvi., **63**, April, 1938, p. 337.) A useful discussion of the problems of the American cotton industry, pointing out the steadily mounting production of cotton in foreign countries, coupled with lower labour costs. The author contends that this competition can only be met by reducing production costs, a statement involving an exceedingly large number of factors—physical, biological, mechanical, economic and human. In his view, however, reduction of costs can be brought about by (1) improvement of cotton quality, (2) increase of total percentage of the longer staples, (3) production of a heavier yield.

615. AN AMERICAN VIEW OF WORLD COTTON PRODUCTION. By P. K. Norris. (*Int. Cott. Bull.*, xvi., **63**, April, 1938, p. 312.) Describing the steady progress of " Outside Growths." The author is of opinion that India will ultimately be one of America's most formidable rivals.

616. LAS ESTACIONES EXPERIMENTALES ALGODONERAS EN LOS ESTADOS UNIDOS DE NORTEAMERICA. By J. R. Lorenzo. (*Bull. No.* 28, Min. de Agr. Buenos Aires, Argentina, 1938.) Brief accounts of the work in progress in a number of experiment stations in the United States that deal with cotton.

617. UNITED STATES COTTON YARN RULES. (*Text. World*, 88, **4**, 1938, p. 58. From *Summ. of Curr. Lit.*, xviii., **10**, 1938, p. 304.) Deals with the Cotton Yarn Rules of 1937, a set of rules for buying and selling cotton yarn developed by the American Carded Yarn Group and the Southern Combed Yarn Spinners Association.

618. COTTON MARKETING IN THE IRRIGATED SOUTHWEST. By J. W. Wright and J. R. Kennedy. (*U.S. Dpt. Agr., Bur. of Agr. Econ.*, June, 1938.) Deals with the place of cotton in the economy of a region; marketing organization and procedure; market prices; and marketing problems. In the last eight years the proportion of total cash income from farm crops contributed by cotton was 43 per cent. in Arizona, 4 per cent. in California, 44 per cent. in New Mexico. Acala represented over 90 per cent. of the total production, even 100 per cent. being reached in some districts; the staple varied from $1\frac{1}{16}$ to $1\frac{5}{32}$ inches.

619. AMERICAN COTTON MILLS: HUMIDIFICATION AND BACTERIAL CONTAMINATION OF ATMOSPHERE. By W. F. Wells and E. C. Riley. (*J. Ind. Hyg. and Toxicol.*, **19**, 1937, p. 513. From *Summ. of Curr. Lit.*, xviii., **11**, 1938, p. 328.) An extensive investigation is described in detail of the particular content of the air in American mills. Much improvement is noted since a similar survey was undertaken in 1912, but the use of impure water and re-circulated water for humidification are recorded as the chief causes of badly infected air. (In Great Britain the purity of the water used for humidification is controlled by the Factory Act).

620. COTTON ROADS IN U.S.A. (*Text. Wkly.*, 3/6/38, p. 746.) In more than twenty states some 500 miles of bituminous road reinforced with cotton fabric have been laid for observation under every kind of soil and weather condition. The results are not yet conclusive, but it is hoped that they will markedly reduce some of the most destructive causes of road failure. The roads are constructed as follows: The sub-surface is prepared in the usual manner, and is given a prime coat of bituminous material; then a single layer of loosely-woven cotton fabric is laid down and given an impregnating coat of asphalt or tar, immediately after which the surface coating of gravel, crushed stone or slag is applied and rolled ready for use. The result is a tough, flexible, bituminous mat, of great resistance to surface wear, squeezing and flattening out under traffic. A mile of roadway uses the equivalent of 8 to 10 bales of cotton.

621. Arizona: Hopi Cotton, a Variable Species. By H. J. Fulton. (*J. Agr. Res.*, 56, 5, 1938, p. 333.) There is much interest at present in Hopi cotton (*Gossypium hopi*, Lewton), a species formerly cultivated by the Hopi Indians of north-eastern Arizona on the Hopi Indian Reservation. This interest, stimulated by tests conducted by the Bureau of Agricultural Economics of the United States Department of Agriculture, has resulted in requests for seed from cotton breeders in America and other countries, who hope to combine the spinning qualities of the aboriginal cotton with the productivity of commercial varieties. Archæologists are interested in Hopi cotton on account of its probable identity with the fibre found in prehistoric ruins in the south-west.

The data presented in this paper indicate that Hopi cotton, formerly grown by the south-western Indians, is heterozygous and capable of modification by selection. Progenies have been isolated that breed true for each character of the following allelomorphs: Yellow and white corollas, (2) yellow and cream-coloured pollen, and (3) smooth and pitted bolls.

622. Arkansas: *Agronomic Research in* 1936-37. (*Forty-ninth Ann. Rpt. of Agr. Exp. Sta. Arkansas*, 1936-37.) The work on cotton included fertilizer tests, varietal trials, breeding experiments, and fibre investigations. In a commercial variety test conducted at the Cotton Branch Station eight varietal characteristics were analysed: acre yield of seed cotton, acre yield of lint, staple length, ginning outturn, boll size, acre value of seed, lint, and seed plus lint. On the upland the leading varieties were Stoneville 2, 5 and 3, while on the delta land the most promising cottons were Lone Star 2124, Stoneville 2, and Arkansas Acala 3075. In a test for resistance to storm damage, varieties showing the greatest resistance were Arkansas Acala 4067 and 1114, Delfos 719, and Dixie Triumph 6; those showing little or no resistance were D. and P.L. 11A, Stoneville 5, Arkansas 17, Arkansas Prolific, Half and Half, and Missdel 7. Presumably, the reason why the large-boll cottons are resistant to storm damage is that the open bolls hang down and the cotton is partially protected by the burrs. In the small-boll cottons, the open boll is more or less upright, and the cotton is exposed to the action of wind, rain, or hail.

In cotton fibre investigations the three varieties with the longest lint were Coker Wilds 7, Missdel 7, and Delfos 531. Some refinements in technique of use, and slight modifications in structure of the photo-electric cotton fibre sorter were effected during the year.

623. Florida: Pure Seed Requirements in the Production of Sea Island Cotton. By W. W. Ballard. (*Circ.* 113, Georgia Exp. Sta., 1937.) The production of Sea Island cotton in Florida and South Georgia has expanded rapidly during the past three years, due to favourable seasons and unusually low weevil infestation. Sea Island cotton is highly susceptible to injury by boll weevil, and the possibility of permanent production of this type is not yet established. Even if satisfactory yields can be produced, permanent establishment of Sea Island cannot be accomplished unless immediate steps are taken to maintain the purity of planting seed, as production of irregular fibre from mixed seed will result in the loss of a satisfactory market for Sea Island fibre. Much of the seed now being planted is mixed with short cotton, and additional mixture will occur unless the requirements of pure seed production are understood by the farmers. The following precautions are necessary to ensure the maintenance of pure planting seed: Do not plant Sea Island cotton closer than one mile from short cotton. Rogue the Sea Island before flowers are produced, just after flowers appear, and after bolls reach full size, in order to remove all undesirable plants or abnormal bolls. Pick the seed cotton into clean sacks, store it in a clean place entirely separate from any short cotton, and thoroughly

dry before storing. Clean the gin premises thoroughly before ginning the Sea Island cotton, and store the Sea Island seed separately from that of any other cotton.

624. OKLAHOMA: ANALYSIS OF THE BUSINESS OPERATIONS OF CO-OPERATIVE COTTON GINS IN OKLAHOMA, 1933-34. By O. T. Weaver and O. W. Herrmann. (*Farm Credit Admin.* [*U.S.*] *Co-op. Div., Bull.* 12, 1937. From *Exp. Sta. Rec.*, 78, **5**, 1938, p. 713.) The importance of co-operative ginning—number and size of associations, volume of ginning, assets, liabilities, etc.—is described. The different expenses and sources of income, factors affecting expenses and income, and distribution of earnings are analysed and discussed.

625. SOUTH CAROLINA: *Field Crops Experiments*, 1936-37. (*50th Ann. Rpt. S. Car. Exp. Sta.*, 1936-37.) The research work on cotton included the following: Studies of the rate and time of application of fertilizers; investigations of cotton wilt disease and of the effect of mineral nutrition on the wilt resistance of an immune and a susceptible variety of cotton; study of variation in cotton fibre length, fineness, and maturity in several varieties; co-operative breeding, genetic, and varietal trials of cotton, and a study of soil improvement and maintenance.

It is stated in the report that the increase in the average staple length of South Carolina's cotton during the past nine years has been outstanding. In 1928 less than 20 per cent. of the crop of the state was 1 inch or longer in staple, whereas 69 per cent. fell within this range in 1936. Equally gratifying has been the trend away from the short and undesirable staples. The proportion of $\frac{7}{8}$ inch and shorter cottons produced in the state dropped from 62 per cent. in 1928 to 6 per cent. in 1936.

COTTON IN EGYPT.

626. EGYPT: *Crop Prospects*, 1937-38. (*Soc. Cotonn. d'Egypte*, 7/7/38. From *Cotton*, M/c, 16/7/38, p. 11.) Weather conditions are favourable and good progress is reported, especially from Upper Egypt, though in some cases there is complaint of water shortage. In the Delta much damage is being caused by leafworm and wilt, especially the former. The collection of egg masses is being carried out energetically with the help of the Government, but it is said that in Lower Egypt the injury is greater than ever before experienced.

627. SOMETHING NEW IN EGYPTIAN COTTON BREEDING. By V. Kulebjaev. (*Sotsialisticeskaja Rekonstruksija Sel'skogo Khozjaistva*, **2**, 1937, p. 227. From *Pl. Bre. Absts.*, viii., **4**, 1938, p. 376.) Two Ashmouni selections with short internodes were used in crossing for the production of a form with compact habit. In the F_3 there appeared certain plants with zero branching—*i.e.*, with bolls formed direct in the leaf axils of the main stem, the stem internodes being unusually short; the resulting plant is thus extremely compact. The general characteristics of the plants are described; in one plant the total vegetation period from sowing to maturity was 138 days, yield per plant 84·7 grm., lint length 36-38 mm., ginning outturn 35 per cent. In another the vegetation period was 140 days, lint length 38-40 mm., yield per plant 73·7 grm., and ginning outturn 34 per cent. These hybrids are thought to be promising on account of the greater density of sowing that they will permit, combined with their suitability for mechanical harvesting.

COTTON IN FOREIGN COUNTRIES.

628. ARGENTINA: *Cotton Crop*, 1937. (*Text. Wkly.*, 24/6/38, p. 867.) The Argentine cotton crop for 1937 is now estimated at 281,000 bales, against an

estimate of 332,000 bales early in March. This is the second year in succession in which production has been substantially reduced by unfavourable weather and insect pests. Dissatisfaction throughout the Argentine cotton area, as a result of low prices this season, is reported, and there is a feeling that if this situation continues it may interfere with the expansion programme of the Argentine Cotton Board.

629. *Boletin Mensual.* (Min. de Agr., Buenos Aires, 1938.) *Bull. No.* 34 contains various articles in Spanish dealing with "The estimation of the area planted to cotton in 1937-38," "Register of the varieties of cotton," "A Chronology of Genetics" (R. Cooke). *Bull. No.* 35 contains articles dealing with: The estimated production of cotton in Argentina for 1937-38; the English cotton industry; the improvement of cotton production by employment of societies of producers. *Bull. No.* 36 contains especially a long article on the production of cotton in East Africa, translated from that by P. K. Norris of the U.S. Dept. of Agriculture. Various statistical tables are included in the bulletins, dealing with acreage, production, consumption, prices and exports.

630. Belgian Congo: *Compagnie Cotonnière Congolaise.* The report for 1937 is a record of a successful year. Purchases of seed cotton amounted to 65,175 tons, compared with 54,802 tons in the previous year. 79 ginneries were in operation during the year under review.

631. *Comité Cotonnier Congolais. Bull. No.* 9, 1938, contains the following, among other articles: "Un voyage en Egypte à l'occasion du XVIII^{e} Congrès International du Coton" (A. de Bauw), an interesting paper dealing with cotton cultivation in Egypt, discussing the varieties grown, pests and diseases, ginning, marketing, etc; "La campagne cotonnière au Congo Belge"; "Création de sous-stations expérimentales au Congo"; "L'extraction de l'huile de coton." Notes on cotton in other countries, legislation, marketing, etc., are included.

632. Brazil: *Cotton Industry,* 1937-38. (*Int. Cott. Bull.*, xvi., **63**, 1938, p. 308.) A preliminary estimate for the cotton crop is 2,282,000 bales (478 lb. each), but this estimate may be substantially reduced, especially if climatic conditions in Southern Brazil are unfavourable, or if insect damage should develop.

633. The Classification of Chinese Cotton. By Y. C. Lee. (*Int. Cott. Bull.*, xvi., **63**, April, 1938, p. 322.) A useful reference article. Standards of variety are Chinese-American, long and short staple, and four types of Native cotton. Standards of grade range from Middling Fair to Good Ordinary. Standards for length rise by sixteenths from ½ to 1¼ inch. Uniformity is classed as "Uniform" (92·5 per cent. or more), "Medium" (85-92·4 per cent.), "Irregular" (84·9 per cent. or less). Strength is classed as "strong" (average fibre breaking load 10·5-7·5 gm.), "medium" (7·4-4·5 gm.), and "weak" (4·4-1·5 gm.).

634. Italy: *Cotton Industry Conditions.* (*Text. Wkly.*, 6/5/38, p. 610.) From the report for 1937 of the Cotonificio Cantoni, Milan, one of the largest cotton concerns in Italy, we learn that the improvement in business which set in in the second half of 1936, continued during the greater part of 1937. Towards the end of 1937, however, the fall in the raw cotton market brought stagnation in sales which has persisted up to now. It is not considered that the year 1938 will be an easy one, although the company has taken steps to ensure its ability to withstand more serious difficulties on the sales side. Exports of cotton products are being prosecuted with energy and with some success, and production costs have also been reduced.

635. *Cotton Industry*, 1937. (*Int. Cott. Bull.*, xvi., 63, April, 1938, p. 310.) In 1937 the acreage under cotton was more than doubled, the largest increase being in Sicily, but weather conditions from sowing to picking were definitely unfavourable, especially in Sicily, where crops were also attacked by greenfly. Yields were below average, but the quality generally was good.

636. COTTON CULTIVATION IN ITALY. By M. Ragno. (*Textilia*, 13, 1937, p. 531. From *Summ. of Curr. Lit.*, xviii., 12, 1938, p. 343.) The history of cotton cultivation in Italy is reviewed. Figures for the area under cultivation are given, and the varieties grown are briefly described.

637. COTTON CULTIVATION IN ITALY AND ITALIAN COLONIES. By L. Geisser. (*Klepzig's Textil Z.*, 41, 10, 1938, p. 1. From *J. Text. Inst.*, xxix., 5, 1938, A259.) Raw cotton consumption and imports, production, equipment and other statistics for the Italian cotton industry are discussed, and the decline in imports of raw cotton and the increasing use of artificial fibres in recent years are pointed out. The production of ginned cotton in Italy amounted to 4,229,700 kg. in 1937, and the probable production in 1938 is estimated at 10,000,000 kg. Plans for the development of cotton cultivation in Abyssinia are described.

638. THE JAPANESE COTTON INDUSTRY: CONTROL MEASURES AND THE PRESENT POSITION. (*Text. Wkly.*, 6/5/38, p. 619.) Control of imports of raw cotton was introduced early in 1937, but did not become effective until after the beginning of the war with China in July. In an attempt to confine the restriction to cotton imported for the needs of the home market the Government imposed a tax on imports of raw cotton, and paid a rebate equivalent to the tax to all exporters of cotton goods.

After a discussion, the paper ends as follows: "The immediate future of the Japanese cotton industry appears to depend entirely on the policy adopted by the Government towards raw cotton imports. At the moment the Government appears reluctant to allow any substantial increase in imports, and if this attitude is maintained, production of yarn and exports of cotton goods may be further curtailed. On the other hand, if the Government adopts the policy of linking up raw cotton imports and exports of cotton goods, Japanese competition in world markets may increase."

639. MEXICO: *Cotton Crop Estimate*, 1938-39. (*Text. Wkly.*, 24/6/38, p. 867.) The Mexican cotton crop for 1938-39 is estimated by the cotton trade at about 260,000 bales; this is based on the assumption that the production in the Laguna district will be approximately 75,000 bales, which is much below normal for that area. If the crop is around this figure relatively little of it will be left for export, as recent consumption has been in the neighbourhood of 215,000/240,000 bales. The domestic price for Mexican cotton is kept at a high level for the benefit of the growers, and is said to average from $5 to $10 U.S. currency per bale above the price for American cotton.

640. PERSIAN COTTON INDUSTRY: DEVELOPMENT, 1935-37. (*Wirtschaftsdienst*, 23, 1938, p. 405. From *Summ. of Curr. Lit.*, xviii., 8, 1938, p. 248.) A table shows the number of mills, spindles, operatives, yarns spun and costs of cotton mills in Iran, 1935-37. Yarn imports decreased from 4,660,000 kilo. in 1931/32 to 10,000 in 1935-36.

641. PERU: *Memoria de la Estacion Experimental Agricola de la Molina*, 1935. We have received a copy of this report, discussing, among other matters, the following in connection with cotton. Experiments on cotton plantations are described; they deal with manuring with guano (nothing less than 3·5 tons to the fanegada, which equals 1·6 acres, was found economically profitable), irrigation

management, etc., and are illustrated with curves. Details of insect damage and treatment are also included.

642. Russia: Achievements of the Odessa Institute of Genetics and Breeding shown at the State Agricultural Exhibition. By M. S. Savitskii. (*Selektsija i Semenovodstvo*, **5**, 1937, p. 19. From *Pl. Bre. Absts.*, viii., **4**, 1938, p. 339.) A condensed outline is given of Lysenko's theories of phasic development; choice of parental pairs and the selection of the progeny in the first hybrid generation; the production of hardy varieties by vernalization followed by autumn sowing; intraracial crossing for the increase of adaptability, quality, hardiness and yield; the summer planting of potatoes to prevent degeneration; the method of cutting off the top of the cotton plant and the monopodial branches, whereby maturity is hastened and yield increased; and the principle of the alteration of the genotype by environmental influence.

643. Swiss Cotton Industry: Statistics. By F. Magri. (*Bollettino Cotoniera*, **33**, 1938, p. 15. From *Summ. of Curr. Lit.*, xviii., **10**, 1938, p. 305.) Statistics are given of the cotton industry in Switzerland, including imports of raw cotton, particulars of the spinning and weaving industries and the labour market, foreign trade in cotton and exports. Diagrams are included showing trends in the trade from 1926 to 1937.

644. The Development of Cotton Production in Turkey. (*Int. Cott. Bull.*, xvi., **63**, April, 1938, p. 320.) The annual consumption of the Turkish cotton spinning industry, allowing for complete shift working, is some 18,293 metric tons of long staple cotton, 24/30 mm. in length, and 7,440 metric tons of shorter staple cottons. In 1937 20,000 metric tons of long staple cotton, and 40,000 metric tons of shorter staple cotton were produced, and after satisfying the requirements of all Turkish spinners, a surplus of 34,263,000 kg. remains for disposal. The authorities are encouraging the development of the industry by the provision of selected seed, demonstrations of modern methods of cotton cultivation and of the technique of mechanization, and the establishment of experiment stations.

SOILS AND MANURES.

645. Soils and Fertilizers. By E. M. Crowther. (Reprinted from *Rpts. of the Progress of App. Chem.*, xxii., 1937.) A useful review of the work of the year in connection with soil science, given under the following headings: Geochemistry and soil problems; Soil surveys and soil formation; Inorganic soil colloids; Availability and fixation of potassium in soils; Plant nutrition; Minor elements; Rapid methods of soil analysis; Soil moisture; Grassland; The Production and use of fertilizers. The review shows the change that is coming over the world in regard to the use of soils. It is at last being recognized that the soil and its fertility form a great part of the capital that has been provided by Nature for the use of the agriculturist, and that if it be recklessly exploited for immediate gain—as has been the case during the past hundred years—Nature will demand payment in some way, as she has demanded it in the past.

646. Bibliography of Soil Science, Fertilizers and General Agronomy, 1934-37. (Imperial Bur. of Soil Science, Harpenden, England, 1938. Price 25s., post free.) Contains 7,500 references to papers published during the period covered, and embraces every subject directly or remotely connected with the soil. The entries have been carefully classified and cross-referenced by the International Decimal System of Classification, and a comprehensive subject index and an author index of 4,500 names are included.

647. Soil Organic Matter and Tropical Agriculture. By D. W. Duthie. (*Agr. J. of Br. Guiana*, viii., 4, 1937, p. 177.) A discussion of the nature of soil organic matter and of the problem of maintaining the organic content of the soil. It is stated that the failure of tropical soils to support continuous " open " cultivation is due mainly to the exposure of the soil, the disappearance of the organic matter, and the consequent removal of the stores of plant food. Nitrogen can be replenished by leguminous crops, but the inorganic nutrients can be saved only by maintaining the organic status of the topsoil. Cover crops or heavy mulching are necessary if there is an interval between the main crops, in order to ensure that the soil is never exposed to leaching.

648. Studies in Soil Fumigation. I. Preliminary Observations. By M. F. Bywaters and A. G. Pollard. (*Ann. App. Biol.*, xxiv., 4, 1937, p. 883. From *Rev. App. Ent.*, xxvi., 3, 1938, p. 166.) *Summary*. Results of preliminary tests of possible methods of investigating the factors controlling the distribution of fumigant vapour in soil are described. Sufficiently uniform and reproducible conditions of pore space in soil may be secured by packing at definite pressures and with a controlled moisture content. A rapid approximate method for determining pore space is described. Carbon disulphide may be satisfactorily removed from soil by aeration methods, and determined, after absorption in alcoholic potash, by the iodometric method. Under the conditions of the experiment (injection of 2 oz. of carbon disulphide at 5 inches depth) the zone of high concentration of the vapour occurs at the level of injection and some 6-7 inches below it. Above the injection concentrations are definitely low. Although movements of carbon disulphide by diffusion are probably dominant factors controlling its distribution in soil, the operation of a more slowly acting factor (possibly biological) effecting destruction of the vapour is indicated.

649. Studies in Soil Fumigation. II. Distribution of Carbon Disulphide in Soil Fumigated under Various Conditions. By J. C. Higgins and A. G. Pollard. (*Ann. App. Biol.*, 24, 4, 1937, p. 895. From *Rev. App. Ent.*, Ser. A, 3, 1938, p. 166.) The following is the authors' summary: Experiments on the lines indicated in the preceding paper, but with improved methods, confirm that the depth-distribution of carbon disulphide in soil fumigated by injection is characterized by a high concentration in the zone of injection and immediately below it, a rapid increase in concentration as the surface is approached, a somewhat slower decrease with depth below the zone of infection, and a time-concentration curve for each individual layer representing a sharp rise to a maximum concentration, followed by a slower decline to a low level which is normally reached in about twenty-four hours. Variations in the depth of injection raise or lower the zone of high concentrations without appreciably affecting that in the surface 0-3 inch layer. Increased amounts of carbon disulphide per injection increase the persistence of the effective concentration of fumigant, without causing any marked change in distribution or in the maximum concentrations attained. Experimental data indicate that the loss of fumigant from treated soil occurs very largely via the soil surface. Effective concentrations of carbon disulphide could not be produced in the surface layer by variation of the depth or amount of the injections, nor by covering the surface with sacking. The nature of the concentration gradients of carbon disulphide in soil suggests that movement of the vapour is largely a simple diffusion process, but that in coarse textured or loosely packed soils a gravitational flow (as of a viscous fluid) may occur to a limited extent. There is no evidence that such gravitational flow proceeds to any considerable extent. The concentration of carbon disulphide is uniformly low at all depths after about twenty-four hours.

650. Movement of Moisture in Soil. By M. R. Lewis. (*Oreg. State Hort. Soc. Ann. Rpt.*, 28, 1936. From *Exp. Sta. Rec.*, 78, **3**, 1938, p. 301.) The author, an irrigation engineer of the Oregon Experiment Station, and the U.S.D.A. Bureau of Agricultural Engineering, considers the relationship of the plant to soil and soil water as " one of dynamics, that is of moving bodies and changing forces. Water is continually moving from the moist soil to and into the roots and through the plant to the leaves, where it is evaporated." He finds that " water will not move by capillary action more than a few inches at a rate fast enough to be of any importance to tree or nut growth; secondly, that infiltration into the soil may sometimes be very slow and may be very different in different parts of the same grove. Both of these findings mean that the grower needs to study moisture conditions in his soil. A great deal can be learned by the use of a soil augur or a shovel and simple examination of the soil. More can be done by systematic sampling and moisture determination."

651. The High Degree of Accuracy of the Improved Soil Hydrometer used in the Mechanical Analysis of Soils. By G. J. Bouyoucos. (*Soil Sci.*, 44, **4**, 1937, p. 315. From *Exp. Sta. Rec.*, 78, **4**, 1938, p. 452.) In an investigation carried out at the Michigan Experiment Station, the author has shown that " the soil hydrometer, when placed in a soil suspension that has been allowed to settle in order to produce differences in density with depth, indicates the same quantity of soil present as that in the same suspension when it is siphoned off and mixed to produce conditions of uniform density. Furthermore, the amount indicated is the same, within limits of experimental error, as that found by gravimetric determination. These are important facts and establish conclusively that the hydrometer method is practical and accurate. At the same time they prove that certain criticisms of the method based on theoretical considerations are invalid."

652. Soil Survey Work in Ceylon. By A. W. R. Joachim. (*Trop. Agriculturist*, March, 1938, p. 149.) The principles underlying, and the methods employed in soil survey work are briefly explained.

653. Soil Erosion in Ceylon. By W. C. Lester-Smith. (*Trop. Agriculturist*, March, 1938, p. 158.) A broadcast talk dealing with the causes and evil effects of soil erosion, and calling upon the agricultural and the urban populations for combined work in soil conservation.

654. Wind Erosion and Means of Control. By J. Hopfen. (*Mnthly. Bull. of Agr. Sci. and Practice*, Rome, June, 1938, 219T.) A brief discussion of the problem of soil erosion in the United States, Australia, and Russia, with suggestions for control.

655. Humus, Fertilizers, and Plant Nutrition. By R. E. Stephenson. (*Better Crops with Plant Food*, 20, **9**, 1936. From *Exp. Sta. Rec.*, 78, **4**, 1938, p. 457.) A semi-popular discussion of theories concerning the functions of soil humus in plant nutrition.

656. Effects of Superphosphate upon the Yield and Earliness in Maturity of Cotton. By C. B. Williams *et al.* (*N. Car. Sta. Bull.* 314, 1937. From *Exp. Sta. Rec.*, 78, **6**, 1938, p. 776.) The phosphoric acid requirements of cotton grown on four Piedmont and three Coastal Plain soil types of North Carolina were studied, 1930-32, with support by the Superphosphate Institute.

In the Piedmont soil province the yield of seed cotton as an average of eight trials rose from 651 lb. per acre where only nitrogen and potash were applied, to a maximum of 960 lb. per acre when these two nutrients were supplemented by enough phosphoric acid to bring the formula to 4·12-15·3. Effects of phosphoric acid were particularly marked on Davidson clay loam and only

slightly less on Georgeville sandy loam. Increases in yield resulting from use of phosphoric acid in experiments on the Coastal Plain soils were less striking, although profitable yield increases ordinarily were secured. Efficiency of all fertilizers, especially phosphoric acid, was found to vary with the season. Increase in the percentage of phosphoric acid resulted in an earlier crop as measured by percentage of total yield secured at first picking. The phosphoric acid content of the fertilizer was found to be of increasing importance with the rate of application, this trend being most marked in experiments in the Piedmont.

657. SELENIUM AS A STIMULATING AND POSSIBLY ESSENTIAL ELEMENT FOR CERTAIN PLANTS. By S. F. and H. M. Trelease. (*Sci.*, **87**, No. 2247, 1938, p. 70.) Plants of *Astragalus racemosus* showed marked stunting when deprived of selenium.

658. SELENIUM ABSORPTION BY PLANTS AND THEIR RESULTING TOXICITY TO ANIMALS. By A. M. Hurd-Karrer. (*Smithsn. Inst. Ann. Rpt.*, 1935, p. 289. From *Exp. Sta. Rec.*, 78, **5**, 1938, p. 604.) Previously published accounts of selenium absorption by plants and of selenium poisoning are reviewed (with twenty-four references to the literature), following which the author presents her own data on the amounts taken up by wheat and by various annual crop plants from sodium selenate added to the soil, on the selenium in successive crops cut from the same roots, and on the toxicity of selenium to plants in relation to sulphur. By sulphur treatments the entrance of selenium into the plants was greatly reduced, and it was apparent from the results obtained that its toxicity for plants was determined by the proportionate amount present with reference to sulphur. Possible explanations of such effects are presented. The high sulphur absorption of members of the mustard family was invariably associated with a high selenium intake and the lower sulphur absorption of cereals with a lower selenium intake, while the legumes occupied an intermediate position.

Not only rats, but also red spiders and aphids, showed a disinclination to feed on selenium-containing plants. Algæ grew well in solutions nourishing plants on which aphids died, and wheat mildew and smut attacked wheat plants containing relatively large amounts of selenium.

659. THE RATE AND TIME OF APPLYING POTASH FERTILIZERS TO COTTON. By H. P. Cooper and R. W. Wallace. (*50th Ann. Rpt. S. Car. Exp. Sta.*, 1936-37, p. 127.) An experiment was commenced in 1931 and conducted over six years, in which all plots received the equivalent of 600 lb. of a 7·5-10-0 fertilizer mixture annually. Potash was supplied at the rates of 0, 15, 30, 45, and 60 lb. per acre, which, with the basic mixture, are equivalent to applications of 600 lb. per acre of 7·5-10-0, 7·5-10-2·5, 7·5-10-5, 7·5-10-7·5, and 7·5-10-10 fertilizer respectively. Results showed little difference in yield from the various times of applying potash, but the yields of seed cotton increased as the amount of potash in the fertilizer increased. The average yield for the six years from plots not receiving potash was 621 lb. seed cotton per acre. The yields from plots receiving 15, 30, 45 and 60 lb. potash per acre were 947, 1,218, 1,338, and 1,490 lb. seed cotton per acre respectively. The data showed that there was an increase of 14·5 to 21·7 lb. seed cotton per acre from each pound of potash applied.

660. STUDY OF STARVATION SIGNS ON TOBACCO AND COTTON. By C. B. Williams. (*Better Crops with Plant Food*, 21, **10**, 1937. From *Exp. Sta. Rec.*, 78, **6**, 1938, p. 795.) This note from the North Carolina State College refers to potash and magnesium deficiency in tobacco and to " sand-drown " (magnesium deficiency) and " rust " (potash deficiency) in cotton, and to their control by small amounts of these elements added to the fertilizer. The foliage effects on both plants are illustrated.

CULTIVATION, IRRIGATION, GINNING, ETC.

661. Some Difficulties in the Statistical Analysis of Replicated Experiments. By W. G. Cochran. (*Empire J. of Exp. Agr.*, vi., **22**, 1938, p. 157.) This paper is an attempt to give, as simply as possible, advice on how to deal with difficulties encountered.

662. A Study of Certain Phases of a Regional Study of Cotton Varieties. By O. A. Pope. (*Proc. 38th Ann. Convent. Ass. S. Agr. Wkrs.*, Jackson, Miss., 1937, p. 207. From *Pl. Bre. Absts.*, viii., **4**, 1938, p. 377.) In this study 8 replications of 16 varieties are being grown at 14 locations over a period of three years. Over 60 variables are being studied, including time from planting to emergence, flowering and opening, boll census, yield, disease, ginning data, colour, staple length, tensile strength distribution and spinning value. From the first year's data it appears that length, fineness, seed index, lint index and percentage of lint are largely determined by genetical constitution, while yield, maturity of fibre, strength, and time from planting to emergence, flowering and opening, are modified to a considerable extent by environmental conditions.

663. Analysis of Variance as applied to the Regional Cotton Variety Study. By O. A. Pope and J. O. Ware. (*Proc. 37th Ann. Convent. Ass. S. Agr. Wkrs.*, Jackson, Miss., 1936 (1937), p. 60. From *Pl. Bre. Absts.*, viii., **4**, 1938, p. 377.) In a variety test carried out at four locations it was found that there was, in the combined test, slightly more than a 50 per cent. reduction in the error variance due to the restricted random arrangement and the method of analysis of the data.

664. Égrenage du Coton, ses Relations avec les Méthodes de Culture et de Cueillette. By A. Brixhe. (*Journal d'Agronomie Coloniale*, **29-30**, 1937.) A discussion of ginning technique and of the principal faults of raw cotton from the ginning point of view and how to overcome these faults. The recommendations made are: To pick when the bolls are thoroughly ripe; to dry them in the sun at once when necessary; to handle as little as possible; not to heap up the cotton more than can be avoided.

665. Cotton Ginning Machine. By I. Sicramaz, (Adana, Turkey). (B.P. 484,087 of 27/10/37, 27/4/38. From *Summ. of Curr. Lit.*, xviii., **11**, 1938, p. 307.) A cotton ginning machine is provided with four revolving knives which are mounted to revolve about a common axis above a grid, and means are provided for automatically opening and closing the grid at predetermined intervals for the purpose of emptying the contents thereof. The machine is particularly suitable for ginning short-fibred cotton.

666. Some Problems in the Successful Operation of Co-Operative Cotton Gins. By W. E. Paulson. (*Southwest. Social Sci. Quart.*, 18, **1**, 1937. From *Exp. Sta. Rec.*, 78, **5**, 1938, p. 714.) The problems of ginning rates, computing patronage dividends, financing gins, and the federation of local gin associations, are discussed.

COTTONSEED AND OIL.

667. The Oil: Gossypol Ratio of Cottonseeds and its Possible Effect on the Refining Loss of Crude Cottonseed Oil. By W. D. Gallup. (*Oklahoma Acad. Sci. Proc.*, **16**, 1936, p. 90. From *Exp. Sta. Rec.*, 78, **2**, 1938, p. 156.) The use of a complete fertilizer for cotton at the Oklahoma Experiment Station was found generally to increase the gossypol, but either nitrogenous or phosphatic fertilizer substances usually decreased the gossypol content. The oil content

was usually higher when the gossypol content was increased. A definite local difference between seeds produced in two counties was noted. Seeds from early- and late-developing bolls showed no consistent differences in oil or gossypol content. Since it is known that fractional percentages of gossypol lessen the alkali-refining loss by from 1 to 3 per cent., "it seems reasonable to assume that, other factors being equally influential, seeds of high oil content will by virtue of their higher gossypol content yield oil with a lower refining loss than will seeds of low oil content."

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

668. Mysore: Report of Work of Entomological Section, 1935-36. By T. V. Subrahmaniam. (*Rpt. Mysore Agr. Dpt.*, 1935-36, Bangalore, 1937. From *Rev. App. Ent.*, xxvi., Ser. A, **4**, 1938, p. 204.) Late-sown cotton was damaged by *Sphenoptera gossypii*, Cotes, which appears to have no alternative food-plants. More than five months elapse between harvest and the sowing of the seed in the black cotton areas, and the adults then feed on the leaves of the old cotton plants; no breeding occurs during this period. A parasite, probably a Trichogrammatid, was reared from the eggs of this Buprestid, and the larvæ were parasitized by the Braconid, *Glyptomorphia smenus*, Cam.

669. United States: Report of the Chief of the Bureau of Entomology and Plant Quarantine, 1937. By L. A. Strong. (*Dpt. of Agr. Washington, D.C., U.S.A.*, 1937. From *Rev. App. Ent.*, Ser. A, **6**, 1938, p. 323.) In connection with work on the cotton bollweevil (*Anthonomus grandis*, Boh.) a survey is given of observations in various States on the effect of calcium arsenate on the soil. The eggs of the cotton flea hopper (*Psallus seriatus*, Reut.) are parasitized by *Erythelmus* sp. in 6 of the southern States, and by *Anaphes anomocerus*, Gir., in Arizona and Texas; it is thought that *Erythelmus*, which is the more important, overwinters in the eggs and that it also parasitizes those of other Capsids. Field tests in Texas with quick-maturing varieties of cotton showed that damage by the pink bollworm (*Platyedra gossypiella*, Saund.) in heavily infested areas can be reduced considerably by selection, and by close spacing and controlled irrigation, which result in early maturity and reduction of late-season damage and of the autumn population that hibernates. Although large quantities of arsenicals were used to control the cotton leaf-worm (*Alabama argillacea*, Hb.) in 1936, it caused serious injury where it appeared early in the season. Defoliation of the mature plants resulted in a great reduction of the overwintering population of *Anthonomus grandis*. In tests carried out in August in Mississippi dusting increased the yield by 288 lb. seed cotton per acre. The thurberia weevil (*Anthonomus grandis thurberiæ*, Pierce) is unable to maintain itself exclusively on cultivated cotton under normal conditions in southern Arizona, and wholesale eradication of its native food-plant *Thurberia thespesioides* is therefore being undertaken on the mountain ranges nearest the cotton-growing districts.

670. Queensland: Pests of Cotton in 1937-38 Season. By W. J. S. Sloan. (*Queens. Agr. J.*, March, 1938, p. 270.) Briefly discusses measures of control for corn earworm and leaf-eating insects. For the former two methods are suggested: (*a*) swabbing with a mixture composed of 1 lb. lead arsenate, 1 gallon molasses, and 6 gallons water, at the rate of 10-15 gallons per acre; (*b*) dusting with calcium arsenate or lead arsenate at the rate of 5-7 lb. per acre, two dustings at an interval of four or five days being advocated. With the first method usually one application only is required.

For the leaf-eating pests swabbing with a mixture of 1 lb. lead arsenate, 1 gallon molasses, and 12 gallons water is recommended. About 10-20 gallons per acre are required, and if the infestation is very heavy a second application may be necessary.

671. SOUTH CAROLINA: *Cotton Pests*, 1936-37. (*50th Ann. Rpt. S. Car. Exp. Sta.*, 1936-37.) Damage by thrips was more pronounced than in the previous season, largely owing to unusually cool weather hindering cotton from making rapid growth. After being outnumbered by *Sericothrips variabilis* last year *Frankliniella fusca* was again decidedly the most abundant species. *F. tritici* was also present but to a lesser degree. Control work was more extensive, and consisted in comparing the value of six insecticidal treatments: sulphur; sulphur and paris green 9-1; sulphur and paris green 14-1; sulphur and calcium arsenate 3-1; black strap molasses, calcium arsenate and water 1-1-2; and phenothiazine and talc 1-9. The 325 mesh sulphur alone and 1-1-2 molasses mixture gave a greater reduction in population than the other treatments.

Increasing injury to cotton has been caused during the past four years by cotton root aphids. Three species are usually present, and in the order of their abundance these are: *Anuraphis maidi-radicis*, Forbes, *Trifidaphis phaseoli*, Pass., and *Rhopalosiphum* sp. The most practical control measure appeared to be mixing some insecticide or repellent with the fertilizer and applying the mixture directly to the soil. Six different insecticides were used as follows: 80 lb. creosote per acre; 50 lb. calcium cyanide per acre; 400 lb. of ground tobacco stems and leaves per acre; 100 lb. flaked naphthalene per acre; 80 lb. ground derris root (containing 4 per cent. rotenone) per acre; 100 lb. of sulphur per acre. No significant difference between any of the treatments appeared in the number of aphid colonies, in the percentage reduction in stand, or in the boll counts. It may be stated that all the treatments were applied lightly, and it is probable that heavier applications would have shown better results. No harmful or undesirable effects were noted in the growth of the cotton plants from the use of any of these insecticides when applied to the soil in the amounts stated.

672. TANGANYIKA: COTTON PESTS IN 1937. By W. V. Harris. (*Entomologist's Rpt., Dept. of Agr., Tanganyika*, 1937.) Cotton pests were little in evidence during the year, the chief pests encountered being pink bollworm, stainers, and Helopeltis bug. During December pink bollworm was reported for the first time in the Lake province. Stainers were most numerous in Shinyanga, but in other areas were below normal. A Tachinid parasite was observed to attack adults and nymphs of the stainers *D. fasciatus* and *D. cardinalis*, and examination showed 1·5 per cent. of the females of the former species to be parasitized. Predatory Reduviids appear to exercise the greatest control on stainers. Some injury to cotton was also caused by crickets (*Brachytrypes membranaceus*), Apion weevil, and in the coastal districts by field mice.

673. THE NON-TOXICITY OF GOSSYPOL TO CERTAIN INSECTS. By E. P. Breakey and H. S. Olcott. (*Sci.*, **87**, No. 2248, 1938, p. 87.) The cotton seed produced in America represents a potential production of 40-80,000 tons of gossypol, and the possible uses of this are being investigated. Its anti-oxygenic action may be useful. As it is poisonous to mammals and birds its insecticide value was tried upon aphids and Mexican bean beetle, but to these it proved harmless.

674. PRACTICAL RESULTS OF AN EXPERIMENT: A BIOLOGICAL METHOD OF CONTROLLING PESTS OF LUCERNE AND COTTON. By V. V. Yakhontov. (In Russian.) (*Vuisshaya Shkola No.* 1, Moscow, 1937. From *Rev. App. Ent.*, xxvi., Ser. A, **4**, 1938, p. 238.) In investigations carried out in 1935 and 1936 in northern Uzbekistan, southern Kazakstan and south-western Kirghizia the

Coccinellids, *Brumus octosignatus*, Gebl., and *Semiadalia undecimnotata*, Schneid., proved useful in the control of aphids on cotton. In field experiments the Coccinellids destroyed the aphids in two days. It was found that the beetles do not remain long in the cotton fields during the hot weather in the summer. The only natural enemy of any importance attacking these Coccinellids is a fungus, *Tarichium jachontovi*, which infests them when they are hibernating.

675. Toxicity of Selenium fed to Swine in the Form of Sodium Selenite. By W. T. Miller and H. W. Schoening. (*J. Agr. Res.*, June, 1938, p, 83.) Considerable loss of livestock in the north-central Great Plains of America is due to a complaint known locally as alkali disease. The presence of selenium in the grain grown in an area where the so-called alkali disease existed appeared to be a responsible factor in the production of the disease, and experiments were undertaken to study the effects on swine of selenite added to the daily ration in the form of sodium selenite. The animals fed varying proportions of sodium selenite in the grain ration died in from 10 to 99 days, and showed all the symptoms of the so-called alkali disease. The control pigs fed the same grain without the addition of sodium selenite made normal gains in weight and remained healthy at all times.

676. Temperatures at which Bollweevils Freeze. By E. Hixson and C. A. Sooter. (*J. Econ. Ent.*, 30, 6, 1937, p. 833. From *Rev. App. Ent.*, xxvi., Ser. A, 5, 1938, p. 274.) The following is the authors' summary of studies made in Oklahoma: The cotton bollweevil (*Anthonomus grandis*, Boh.) is much more resistant to cold than was formerly supposed. The undercooling temperatures of 991 bollweevils show a range from 26·6° to − 9·4° F. Those undercooled in November and February were the more resistant, those undercooled in December and March were the least resistant. Winters having low minimum temperatures were followed by small field populations of hibernated weevils, whether the population the previous year was large or small.

677. Hyderabad: *Campaign against Bollworm.* (*Text. Wkly.*, 22/7/38, p. 110.) A vigorous campaign against the bollworm has been undertaken in Hyderabad, where damage by the pest is costing the cotton growers more than £750,000 a year. The recommendations made are that cattle, sheep, and goats should be left to graze in the fields after the crop has been harvested; all cotton plants removed afterwards, no seed to be left unginned; no seed cotton or cottonseed to be imported from bollworm areas; early ripening varieties of cotton to be cultivated, as being less liable to bollworm attack.

678. Bollworms of the Family Gelechiidæ. By D. D. Goloviznin. (In Russian with a summary in English.) (*Sotz. Nauka Tekh.*, 5, 1, Tashkent, 1937. From *Rev. App. Ent.*, xxvi., Ser. A, 5, 1938, p. 249.) *Platyedra* (*Gelechia*) *malvella*, Hb. and *P. vilella*, Zell., are both abundant on wild malvaceous plants in Uzbekistan, but have not been studied there, though *P. malvella* was found in raw cotton in 1935 and in 1936. Characters distinguishing the larvæ of these two moths from each other and from those of *P.* (*Pectinophora*) *gossypiella*, Saund., are described, and an account is given of the bionomics of *P. vilella* based on observations carried out in 1933 in northern Persia, where it caused serious damage to cotton in 1932.

The adults appeared in March and there were five generations during the year, the life-cycle being completed in 26-40 days. Cotton and wild Malvaceæ were both attacked, but first-generation larvæ were confined to the latter. In September and October, some of the larvæ entered hibernation in the soil near their food-plants. Apparently, however, hibernation may also occur in the adult or pupal stage. On cotton, the larvæ fed chiefly on the fruit-bearing

organs, but sometimes attacked the young stems. In the insectary, eggs were laid on the bolls, usually singly, but sometimes up to 8 eggs were observed on bolls in the field, probably deposited by several females. The number of eggs laid by a female varied from 18 to 252, but was usually about 120, deposited at the average rate of 12 in twenty-four hours. The oviposition period, which began on the second day after emergence, averaged ten days, with a maximum of eighteen. The young larvæ gnaw their way into the bolls, in which they feed on the seeds; bolls attacked by the older larvæ become infested with fungi. Up to 8 young larvæ may be present in a boll, but the older ones tend to occur singly. A larva usually infests one boll only, but if this is attacked by fungi it passes to another and may thus damage several. The average duration of the larval stage is fourteen days. When full-fed, the larvæ abandon the bolls and usually pupate in the soil at a depth of about 6 inches. Occasionally, however, pupation occurs on the soil surface under different kinds of shelter, or in the stems or bolls and on the leaves of the cotton plants. The adults hide during the day, chiefly in cracks in the soil, and become active only at night.

679. Pink Bollworm (*Platyedra gossypiella*, Saund.). By T. H. C. Taylor. (*Ann. Rpt. of Dept. of Agr. Uganda*, 1936-37, Pt. II., p. 40.) Work has been continued on pink bollworm, and the present paper describes the recent spread of the pest, the resting stage, the extent of damage, and suggested control. The alternative host plants of the bollworm are species of *Hibiscus*, and the growing of these should be discouraged in the wetter areas. The average percentage infestation of bolls has remained low in most areas, and damage has been slight. The margin of safety, however, is small, and any slackening of the enforcement of uprooting and burning of cotton at the end of the season would be dangerous.
[*Cf.* Abstr. 669, Vol. XIV., of this Review.]

680. Pink Bollworm (*Platyedra gossypiella*) in Foreign Literature. Pts. I. and II. By V. V. Yakhontov. (In Russian.) (*Inform. Byull. Obzor inostr. Lit. Khlop.*, No. 7, Tashkent, 1937. From *Rev. App. Ent.*, xxvi., Ser. A, 4, 1938, p. 247.) Includes a bibliography of 613 titles.

681. Studies on *Platyedra gossypiella*, Saunders in the Punjab. IV. The Incidence of *Platyedra gossypiella* in Relation to Climate (1926-1931). By M. Haroon Khan. (*Ind. J. of Agr. Sci.*, viii., 2, 1938, p. 191.) *Summary*. The distribution and the incidence of *P. gossypiella* in the Punjab have been studied by the examination of green bolls from twelve stations. The results obtained show that: The attack on green bolls starts from the time they are available and increases with the progress of the season; the intensity of attack varies from year to year, the same locality showing wide fluctuations during different years; the pest is serious in certain parts of the province and negligible in others.

On the basis of the normal incidence of *P. gossypiella* the province may broadly be divided into four zones as follows: (i.) zone of "normal outbreaks" where over 15 per cent. of green bolls produced are attacked, situated to the east of the 15-inch rainfall line; (ii.) zone of "occasional outbreaks" where over 5 and up to 15 per cent. of the green bolls produced are attacked, situated between 11- and 15-inch rainfall lines; (iii.) zone of "possible outbreaks," where over 1 and up to 5 per cent. of the green bolls are attacked, situated between 8- and 11-inch rainfall lines; (iv.) zone of "no outbreaks" where 1 or less than 1 per cent. of the green bolls are attacked, and which lies west of the 8-inch rainfall line.

Generally speaking, in places where the attack is high the climate is mild and humid, and thus favourable to the procreation of the pest, while in places of low attack the climate is hot and dry and unfavourable to the multiplication

of the pest. Rainfall has been taken as an index of the climatic complex, and a correlation between rainfall and incidence of pest has been attempted.

[*Cf.* Abstrs. **76**, Vol. VI., **617**, Vol. VIII., and **590**, Vol. XI. of this Review.]

682. El Gusano de la Hoja del Algodonero, *Anomis Texana*, Riley. By J. E. Wille and J. M. Lamas. (*Bull. No.* 12, Min. de Fomento, Est. Exp. Agr. de La Molina, Lima, Peru, 1937.) A monographic account of the "Gusano de la Hoja," the Noctuid moth *Anomis texana*, Riley, which is one of the most important pests of cotton in Peru. Calcium arsenate is the control recommended.

683. Observations on *Aphis gossypii*, Glov. and Results of Control Experiments. By M. Eguchi. (In Japanese.) (*Ann. Agr. Exp. Sta. Chosen*, 9, **3**, Korea, 1937. From *Rev. App. Ent.*, xxvi., Ser. A, **6**, 1938, p. 309.) *Aphis gossypii*, Glov., is one of the most serious pests of cotton in Korea, where it also attacks *Hibiscus* spp. pomegranate, cucumber, chrysanthemum, *Portulaca oleracea* and other plants. All forms of this aphid are described, and lists given of its food-plants and natural enemies in Korea and Japan. The aphids are less abundant on cotton in July and August than they are in June and autumn. The optimum temperature for them is 18-23° C. (64·4-73·4° F.), and many are killed by the heat in summer. Winged males and wingless oviparous females appear from mid-October onwards, but they did not occur on cotton in a greenhouse during the winter. The maximum number of generations on cotton in a year is about 28. A viviparous female produces 50-75 young at the rate of 5-7 per day, and a sexual female lays an average of 5 eggs. Natural enemies include a Chalcidoid parasite, the Coccinellid *Coelophora inæqualis*, F., and spiders. Spraying cotton in June with a proprietary derris insecticide mixed with soap has been found an effective control, and it is suggested that sprays of lime-sulphur should be applied in winter to trees on which the eggs are laid.

684. A Preliminary Report of Studies on Control Measures for Chinese Cotton Aphids. By C. Wu. (*Peking Nat. Hist. Bull. No.* 12, Pt. II., Peiping, 1937. From *Rev. App. Ent.*, xxvi., Ser. A, **4**, 1938, p. 245.) Brief notes are given on the morphology of the eggs and the adults of the various forms of *Aphis gossypii*, Glov., and on its life-history on cotton near Nanking. In a greenhouse, 29 generations were produced in a year, and parthenogenetic reproduction continued through the winter. In the field, cotton seedlings often become infested in late spring by aphids migrating from *Capsella bursa-pastoris*. Irrigation, which is practised in dry regions of north China, favours the aphids, heavy rainfall destroys them.

In experiments made with a number of insecticides, a spray of cottonseed oil and soda in the proportion of 3 : 1, diluted in 40 parts of water has 98·5 per cent. control. Another spray recommended contains about 10 oz. soap, 16 oz. sodium carbonate or sodium hydroxide or both, and 16 fl. oz. cottonseed oil in 31 gallons of water. An even cheaper spray was subsequently prepared from a material called soap-stock, which is a compound of soda and oleic acid precipitated when cottonseed oil is refined with sodium hydroxide. The spray is prepared by dissolving soap-stock in hot water and further diluting with cold water. At dilutions varying from 60 to 170 parts water by volume, the percentage mortality varied from 97·52 to 84·35. Diluted in 100-120 parts water, soap-stock gave over 90 per cent. mortality.

685. Preliminary Observations on the Distribution, Food Plants and Original Home and Habitat of *Pempheres affinis*, Fst., the Cotton Stem Weevil of South India. By P. N. Krishna Ayyar. (Conf. of Res. Workers on Cotton in India, 1937. From *Mnthly. Bull. of Agr. Sci. and Practice*, Rome.

April, 1938, 167T.) The species *Pempheres affinis* is confined to India, Burma and the Philippines; three species out of five occur in the Indo-Burma region. It is assumed that the weevil is indigenous to India, and that changing agricultural conditions brought about the introduction and rapid extension of Cambodia cotton, which forms an ideal host for the insect, and from which it subsequently spread to other cotton varieties.

686. Anti-Jassid Resistance in the Cotton Plant. By K. B. Lal. (*Curr. Sci.*, 6, 3, Bangalore, 1937. From *Rev. App. Ent.*, xxvi., Ser. A, **5**, 1938, p. 261.) In view of the fact that the chief factor in the resistance of cotton plants to attack by jassids is the hairiness of the leaves, experiments were made on the correlation of hair density and resistance to attack by *Empoasca devastans*, Dist. at Lyallpur in 1936. Examination of comparable leaves from seven varieties of cotton showed that resistant varieties had short hairs and high hair density; the most hairy American variety, which also had the greatest average hair length, was not the most resistant. Some evidence exists that resistance to jassid attack is due to some peculiarity of the leaf-veins that prevents oviposition.

687. The Outbreak Areas of the Desert Locust (*Schistocerca gregaria*, Forsk.) in Arabia. By R. C. Maxwell-Darling. (*Bull. Ent. Res.*, 28, **4**, 1937, p. 605. From *Rev. App. Ent.*, xxvi., Ser. A, **4**, 1938, p. 198.) The results are given of a survey of possible outbreak centres of *Schistocerca gregaria*, Forsk., in central and southern Arabia, carried out in 1935-36, in continuation of similar work in the Anglo-Egyptian Sudan. Attention was concentrated on areas that were sandy, with perennial grasses and undershrubs, and in which conditions characteristic of outbreak centres were likely to be encountered. The types of country and vegetation and the climatic conditions in the areas surveyed are briefly described. It is pointed out that investigations on *Schistocerca* have reached a stage in which practical measures of control in the outbreak centres, organized on an international basis, can be inaugurated.

[*Cf.* Abstr. **648**, Vol. XIII. of this Review.]

688. *Schistocerca gregaria*, Forsk. ph. *Solitaria* dans le Sud Algerien. By M. Volkonsky. (*C. R. Soc. Biol.*, 126, **34**, Paris, 1937. From *Rev. App. Ent.*, xxvi., Ser. A, **4**, 1938, p. 239.) In November, 1937, solitary adults of *Schistocerca gregaria*, Forsk., were found in the Territoires du Sud, Algeria, in a number of oases in Lower Touat, where they were confined to palm-groves, and in the depressions of the Great Western Erg, with scattered bushy vegetation. All the specimens collected were sexually immature, belonged to typical phase *solitaria*, and showed a very narrow range of biometrical variations.

689. O Apparecimento de *Phlyctænodes bifidalis*, Fab., como Praga do Algodoeiro no Brasil. (The Appearance of *Loxostege bifidalis* as a Pest of Cotton in Brazil.) By H. F. G. Sauer. (*Arch. Inst. Biol.*, **8**, p. 201, S. Paulo, 1937. From *Rev. App. Ent.*, Ser. A, **6**, 1938, p. 333.) Larvæ of the Pyralid, *Loxostege* (*Phlyctænodes*) *bifidalis*, F., all stages of which are described, are fairly common in the state of Sao Paulo on *Amarantus*, *Portulaca* and *Talinum*, and in 1936 they migrated to cotton, when some new cotton fields were cleared of these plants. In laboratory investigations, adults from larvæ collected in the field paired, and the females deposited batches of about 11 eggs on the under-sides of leaves, usually during the night. The pre-oviposition and oviposition periods lasted 12-48 hours and 7-10 days respectively, and the number of eggs deposited by a female averaged 274·5. At temperatures of about 24°-25° C. (75·2°-77° F.) the average durations of the egg, larval, prepupal and pupal stages were about 4, 18, 4 and 8 days.

690. INVESTIGATIONS OF COTTON STAINERS (*Dysdercus* spp.) IN UGANDA. By H. Hargreaves and T. H. C. Taylor. (*Ann. Rpt. of Dpt. of Agr. Uganda*, 1936-37, Pt. II., p. 9.) Details are given of the life history and activities of the four species of *Dysdercus*: *D. nigrofasciatus, superstitiosus, fasciatus*, and *cardinalis*, that are prevalent in Uganda, and of the various parasites found with them, whose value is not yet fully estimated. Among the control measures advocated are: curtailment of the sowing period, which sometimes lasts long enough for two generations of stainers to appear; growing of rapidly maturing varieties of cotton; leaving open bolls in the field no longer than is absolutely necessary for full maturation; cutting down all bushes that keep the soil damp, and cause the breeding of stainers.

691. NIGERIA: *Tsetse Fly Research*. (*Bull. Imp. Inst.*, xxxvi., 2, 1938, p. 223). The following account of tsetse research is contained in the report of Mr. F. D. Golding, Senior Entomologist, Dept. of Agriculture, for the period July to December, 1937.

Two more fly surveys of the proposed unit farm areas in the Ilorin Province were carried out in July-August and in the first half of November. With the exception of two individuals of *Glossina tachinoides*, Westw., all the tsetses collected in the unit farm areas in the three surveys were *G. palpalis*, R. D. A standard system of collecting was employed in order to provide comparative data as to the abundance of fly in each area. On the conclusion of the third survey, the areas were roughly grouped according to the number of flies collected during the three surveys. These data were employed by the Agricultural Officer in charge of the Middle Belt cattle scheme when selecting areas in which to establish the nine new unit farms to be opened in 1938. An interesting feature of the November survey was the abundance of Tabanid flies and *Stomoxys* spp. It is evident that these flies are numerous only between the end of the short dry season and the end of the rains (September and mid-November). Of 899 flies collected by a herdsman on Gold Coast cattle on the Ilorin farm between October 10 and 29, 19 were Tabanids (belonging to the genera *Tabanus, Hæmatopota* and *Hippocentrum*) 153 were *Stomoxys* spp., and 727 were non-biting Muscids. On August 18 *Lyperosia minuta*, Bez. was taken on trade cattle in the market in Ilorin Town; this species was not found on the stock farm two miles away.

692. INTRODUCTION TO PLANT PATHOLOGY. By F. D. Heald. (McGraw-Hill Book Co., New York and London, 1937. From *Exp. Sta. Rec.*, 78, 6, 1938, p. 791.) A somewhat briefer treatment of the subject than is presented in the author's *Manual of Plant Diseases*. This new work is not an abridgment of the more complete manual, but involves much added material and an entirely different order of presentation. An attempt has been made to give the student a general view of the relation of plant diseases to human affairs. Following the introductory chapters the field of plant pathology as a whole is presented in the following sequence: Parasitic diseases, including those caused by fungi, bacteria, seed plants, and nematodes; virus diseases; non-parasitic diseases; plant disease prevention or control; and methods of studying plant diseases. Literature references occur at the ends of chapters, and a subject index is provided.

693. DISEASE OF COTTON PLANTS IN PUERTO RICO, 1935-36. (*Ann. Rpt. of Agr. Exp. Sta. Rio Piedras*, Puerto Rico, 1935-36. From *Rev. App. Mycol.*, xvii., 5, 1938, p. 299.) Young cotton plants were attacked by an *Alternaria* spot, the disease disappearing as the plants developed. The organism, which appeared to be seed-borne, was found to be morphologically different from that causing a similar disease in Trinidad.

694. ABSTRACT OF THE INVESTIGATIONS OF THE PLANT PROTECTION STATION OF THE PAN-SOVIET INSTITUTE FOR SCIENTIFIC RESEARCH ON COTTON. (In Russian.) (*Pl. Prot.*, Leningrad, 1937. From *Rev. App. Mycol.*, xvii., 6, June, 1938, p. 391.) A collection of papers by various authors on the control of blackarm disease of cotton. According to D. D. Verderevsky, a comparison of seed disinfection methods proved that of nine different disinfectants formalin (1 : 100) was the most effective. Experiments on the artificial infection of cotton with *B. malvacearum* showed the following strains to be absolutely immune from the disease: 02129 from Turkey, 5946 and 9331 from South India, 02289-1 from Manchuria, and 2869 from Mozar-y-Sheriff. All belong to the 26-chromosome group, whereas the species usually grown in U.S.S.R., such as *Gossypium hirsutum* and *G. barbadense* belong to the 52-chromosome group. Recent investigations indicate the possibility of breeding immune hybrids between these two groups.

In a further paper on hot-water treatment of cottonseed as a measure of control against *B. malvacearum*, seed heated for an hour in hot water at 56°-59° C. was almost completely sterilized.

Mme. N. P. Lebedeva reports investigations on the bacteriophage of *B. malvacearum* in the course of which its presence was established in cotyledons, leaves, stems, and bolls of herbarium specimens and living diseased cotton plants. It was also found in the water of ponds near cotton plantations and the river Lybed near Kiev. Tests showed that a temperature of 56° to 59° C. is lethal to the bacteriophage only after 60 mins. exposure, whereas *B. malvacearum* is killed after 10 mins. exposure at 54° to 56° C. The lysis is most effective for all strains of the bacterium at a temperature of 20° to 37° C. Three months' desiccation did not destroy the bacteriophage. The influence of sunlight was ineffective up to two hours, but after three hours' exposure either the lysis was lessened or the bacteriophage destroyed. It was possible to select three bacteriophages out of seven examined which were lytic to all of the 25 original strains of *B. malvacearum* tested. Field experiments in 1936 in Tashkent showed that bacteriophage treatment of cotton seeds in combination with vernalization lowered the infection by 74 per cent. in comparison with the control, but treatment of the seeds shortly before sowing showed very little effect.

695. COTTON LEAF CURL IN AZERBAIDJAN. By S. N. Moskovetz. (*Pl. Prot.*, Leningrad, 1937. From *Rev. App. Mycol.*, xvii., 6, June, 1938, p. 392.) Leaf curl disease of cotton was first observed in Azerbaidjan in 1934, when 1 to 2 per cent. of the crop was diseased (20 per cent. in a few districts) the Egyptian varieties being mainly affected. In 1935 the incidence amounted to 7·8 and 10·2 per cent. on the Egyptian strains Fuadi and Maarad respectively, and to 0·5 to 1 per cent. on the Upland varieties, and increased still further in the following year. In some varieties the yield of lint was reduced by 1·1 to 2·7 per cent., and the staple was shorter by 1·9 mm.

696. CRINKLE LEAF, A NEW DISEASE OF COTTON IN LOUISIANA. By D. C. Neal. (*Phytopathology*, xxvii., 12, 1937, p. 1171. From *Rev. App. Mycol.*, xvii., 5, 1938, p. 317.) A new cotton disease, described as "crinkle leaf" is prevalent in certain localized areas on Lintonia and Olivier silt loam ("bench" or "bluff") soils in Louisiana, where it was first observed in 1934 by H. B. Brown, of the Agricultural Experiment Station. Several Upland varieties are affected, including Half and Half, Clevewilt, Express, Dixie-Triumph, Deltapine, and a Sea Island × Upland hybrid. The leaves are puckered, mottled, semi-chlorotic, and distorted in the early stages; subsequently necrotic lesions develop along and between the veins, and approaching maturity is accompanied by thickening, brittleness and marginal raggedness. The branches are usually fasciated, though

apparently normal ones sometimes arise from the basal nodes of the diseased main stem. The involucral bracts, floral buds, flowers, and bolls are abnormally small and often markedly asymmetric, the bracts and bolls also being deficient in chlorophyll. Distorted bolls mature very irregularly, producing weak fibre and almost worthless lint. The cortical, pith, and vascular tissues of the terminal branches are imperfectly developed and the normal metabolism of the plant thereby greatly impeded. "Crinkle leaf" presents certain analogies with previously reported abnormalities, including crazy top and inherited "round" or "crinkly" leaf, from which it differs, however, in various distinctive features and in the manifest absence of any hereditary tendency. Inoculation experiments and attempts to transmit the disorder by grafting gave negative results, but symptoms similar to those described above have been observed on greenhouse cotton plants grown in steam sterilized Lintonia silt loam soil.

697. *Nematospora gossypii*: Nitrogen Requirements in Synthetic Media. By H. W. Buston *et al.* (*Ann. of Bot.*, 2, 1938, p. 373. From *Summ. of Curr. Lit.*, xviii., 12, 1938, p. 364.) Observations of the growth of the internal boll-rot organism *Nematospora gossypii* in synthetic media containing amino acids, ammonium salts and asparagin, and of the influence of β-alanine, aspartic acid and asparagin on growth are described. In the presence of inositol (10 mg. per 100 c.c. of medium) and of sufficient amounts of the "secondary accessory factor" (from lentils) *Nematospora gossypii* is able to grow on a medium whose sole nitrogenous constituent is asparagin, or ammonium aspartate; simple mixtures of amino acids including aspartic acid are also suitable, and tryptophan is not essential. Ammonium salts of inorganic acids and of most organic acids are not adequate as a source of nitrogen, but in the presence of β-alanine (1-10 mg. per 100 c.c.) moderate growth is obtained; *l*-aspartic acid (100 mg. per 100 c.c. medium—*i.e.*, providing 3·5 per cent. of total nitrogen) stimulates growth on ammonium salt media to the extent of about 90 per cent. of the standard growth on gelatin hydrolysates or on asparagin.

698. Phymatotrichum (Cotton or Texas) Root Rot in Arizona. By R. B. Streets. (*Tech. Bull.* 71, *Ariz. Agr. Exp. Sta.* 1937. From *Rev. App. Mycol.*, xvii., 5, 1938, p. 316.) In this paper the author gives an account of root rot caused by *Phymatotrichum omnivorum* on cotton and numerous other hosts. He states that the fungus has a host range of over 1,700 species of plants. The total annual losses in Arizona from root rot caused by this fungus are estimated at $500,000 as compared with $100,000,000 in Texas and $50,000,000 in six other affected States combined. The symptoms and the characteristics of the fungus are described. The most effective control measures are stated to be long-term rotations with non-susceptible crops (at least three years), clean cultivation, heavy applications of organic manure, a dressing of 4,350 lb. ammonium sulphate per acre, followed by irrigation, soil disinfectants, barriers in the form of rows of non-susceptible crops, or trenches filled with a mixture of soil and sulphur (2 to 4 per cent.) waste oil, or crude carbolic acid, and surface applications of sulphur, on which experimental work is in progress. A bibliography of 157 titles is appended.

699. Cytology of Phymatotrichum Root Rot of Cotton Seedlings grown in Pure Culture. By G. M. Watkins. (*Amer. J. Bot.*, xxv., 2, 1938, p. 118. From *Rev. App. Mycol.*, xvii., 7, 1938, p. 456.) Roots of cotton seedlings grown aseptically and inoculated with *Phymatotrichum omnivorum* in pure culture were gradually covered by a dense weft of fungous hyphæ. Sections of roots fixed at 24-hour intervals showed that roots coming into contact with the cut surface of the sclerotium or agar discoloured by a sclerotium, are usually inhibited

in growth and occasionally develop sunken necrotic areas even before being attacked by hyphæ. The agglomeration of hyphæ over the root either brings about the death of the epidermis and cortex down to the central cylinder, or single hyphæ penetrate the epidermis pericycle, and ultimately the tracheids of the xylem. While the penetration process may conceivably involve a combined mechanical and chemical activity on the part of the fungus, the cytological evidence indicated a dominant part played by enzymic exudates. As far as has been observed, no symbiotic association of fungus and living host cells took place, and moribund root cells were frequently seen as much as four cell layers from the fungus. No evidence was seen of the "mechanical wedge" type of penetration which has been reported by various other authors from field experiments.

700. TESTS WITH PENTACHLORETHANE, TETRACHLORETHANE, AND XYLOL TO DETERMINE THEIR EFFICIENCY IN ERADICATION OF *Phymatotrichum* Root Rot. By W. N. Ezekiel. (*J. Agr. Res.*, April, 1938, p. 579.) Experiments carried out with the three fungicides indicated that the incidence of root rot was delayed and its prevalence reduced, but in no case was it completely eradicated from infested plots. The results do not yet justify recommendation of these soil fungicides for practical use against *Phymatotrichum* root rot.

701. STUDIES ON THE CAUSE OF IMMUNITY OF MONOCOTYLEDONOUS PLANTS TO *Phymatotrichum* ROOT ROT. By W. N. Ezekiel. (*J. Agr. Res.*, May, 1938, p. 773.) No monocotyledonous plant has proved susceptible; this appears to be due to the concentration in the roots of some inhibitory substance. 1,708 species of dicotyledons and gymnosperms are known to be attacked.

702. EVALUATION OF SOME SOIL FUNGICIDES BY LABORATORY TESTS WITH *Phymatotrichum omnivorum*. By W. N. Ezekiel. (*J. Agr. Res.*, April, 1938, p. 553.) Methods were developed for evaluating fungicides in the laboratory as to ability to permeate soil, and as to fungistatic and fungicidal effectiveness against the root rot fungus, *Phymatotrichum omnivorum*. Of the group of fungicides experimented with pentachlorethane, tetrachlorethane, and xylene showed ability to penetrate moist soil and prevent growth of *P. omnivorum*, together with high fungicidal value after passage through air, and these materials are suggested as promising soil fungicides for trial in field experiments. None of the fungicides mentioned in the paper, however, are recommended as yet for practical use against *Phymatotrichum omnivorum*.

703. SEED INFESTATION WITH *Glomerella* AND *Fusarium* IN THE 1936 COTTON CROP IN NORTH CAROLINA. By S. G. Lehman. (*Plant Dis. Reptr.*, xxii., **1**, 1938. From *Rev. App. Mycol.*, xvii., **6**, June, 1938, p. 392.) In germination and disease tests made in 1937 in 35 lots of untreated cottonseed from 35 different farms in 19 counties in North Carolina, an average of 81 per cent. of the seeds germinated. In all except 4 lots, 40 per cent. at least of the seeds showed the presence of *Glomerella gossypii*, the range percentage infection being 4 to 96, with a mean of 65·9. The average percentage of seeds bearing spores or mycelium of *Fusarium* was 31·4. In additional tests made on seed from 24 of the same lots after delinting in acid and disinfection with mercuric chloride, the mean percentages of infection by *G. gossypii* and *Fusarium* spp. were only 8·1 and 6·3 respectively, the incomplete elimination of these fungi by the treatment being probably due to internal seed infection.

704. ARKANSAS: COTTON DISEASES, 1936-37. By V. H. Young *et al.* (*49th Ann. Rpt. of Agr. Exp. Sta. Arkansas*, 1936-37.) A brief account is given of a genetical, physiological, and pathological study of the cotton plant with special reference to cotton wilt and the breeding of wilt-resistant strains. Half-and-Half proved

very susceptible to wilt, among the resistant varieties being Coker Clevewilt 3, Lightning Express 8, Dixie 14-5 and 14-1, Dixie Triumph 25, Rhyne's Clevewilt, Rhyne's Cook, and Arkansas 17.

A study of the etiology and control of seedling blights and boll rots of cotton in Arkansas indicated that the organism most commonly isolated from seedling blight (soreshin) in the state appears to be *Rhizoctonia solani*. In a series of seed treatments consisting of non-treated seed, sulphuric acid delinted seed, seed dusted with ethyl mercury chloride dust, and seed treated with a dust consisting of zinc oxide and zinc hydroxide, some increase in yield seemed to result from sulphuric acid delinting; other treatments were without significant results. Although all treatments reduced the number of initial infections of *Bacterium malvacearum* in no case was infection completely controlled.

705. Physiological Study of the Tracheomycotic Wilt of Cotton. By Mme. P. V. Sabourova. (In Russian with English summary.) (*Pl. Prot.*, Leningrad, 1937. From *Rev. App. Mycol.*, xvii., 6, June, 1938, p. 392.) Hothouse experiments with Upland cotton No. 169 artificially infected with *Verticillium dahliæ* showed that transpiration was lowered by 30 to 40 per cent. in plants infected in the basal part of the stem and by 15 to 20 per cent. in plants infected at the base of the primordial leaf. The osmotic pressure in the leaves was also lowered by between 2 and 3 atmospheres. Planting in closer stands affording denser shade is recommended as a measure of control.

706. A Micro-Chemical Method for the Determination of the Microflora present in Cotton Fibres and of the Injury caused by it to the Fibres. By Mme. T. V. Schepkina. (*Bull. Acad. Sci. U.R.S.S.*, Ser. Biol. 3, 1937, p. 619. From *Rev. App. Mycol.*, xvii., 3, 1938, p. 173.) The author states that in the course of colorimetric studies involving the use of bromphenol blue as indicator, primarily designed for the determination of the degree of maturity of cotton fibres, it was frequently observed that individual fibres did not stain uniformly over the whole of their length, but presented a spotted or speckled aspect. Further investigations showed that these irregularities in staining were due to the presence, both outside and inside the fibres, of a complex microflora, containing organisms capable of destroying cellulose, since the tensile strength of such fibres was found to be considerably impaired. The examination of a wide range of American and Egyptian baled cottons imported from abroad showed the presence in them of a high percentage (occasionally as much as 80 per cent.) of such fibres. While no systematic study of the microflora was undertaken, it was noted that it comprised widely differing organisms, including besides two bacterial strains, resembling *Bacillus mesentericus* and *B. subtilis*, respectively, species of *Penicillium* and *Aspergillus*, and an Actinomycete, a very minute fungus which was very frequently found growing spirally around the fibres and actively destroying the cellulose of their walls. The same fungus was also detected, with the help of bromphenol blue, growing in the walls of the fibres, in the seeds still enclosed in the bolls, and in the leaves of cotton plants collected in 1936 in Azerbaijan as suffering from a virus disease. The fungus eventually forms on the surface of fibres mulberry-shaped, bright lilac, but later blue fruiting bodies, which break up and liberate hyaline spores.

707. The Nature of Viruses. By T. E. Rawlins and W. K. Takabashi. (*Sci.*, 87, No. 2255, 1938, p. 255.) A discussion of recent papers.

708. Virus Diseases and Viruses. By Sir Patrick P. Laidlaw. (Camb. Univ. Press, 1938. Price 2s. 6d. net.) The study of viruses, both as the smallest organisms known and as the cause of diseases as various as smallpox, influenza and warts, is of outstanding interest to all biologists, biochemists and medical research workers today. Advances in our knowledge of viruses have been and

continue to be exceedingly rapid, and it is difficult to keep abreast of the almost daily discoveries. The non-specialist and the interested layman may take their bearings from Sir Patrick Laidlaw's compact survey of present knowledge.

709. A Discussion on New Aspects of Virus Disease. (Held at the Royal Society on March 17, 1938, and reported in *Proc. R. S.*, Vol. B, **125**, June 16, 1938, p. 291. Price 9s.) In his opening address Dr. R. N. Salaman called attention to the new knowledge of the virus particle now being gained, and was followed by various specialists. He himself dealt with virus strains, describing the six strains of the X virus of the potato, four of which are mild and do not produce local lesions on potato and tobacco, while the two others do so. If a healthy plant be inoculated with one of the four, and 7-10 days later with one of the two latter, no further reaction occurs, and only rarely can the second virus be traced. This fact he considers to imply the existence of a radicle common to all the strains, while the differences between the strains in their effects are due to other and different radicles. All changes, spontaneous or experimental, have been from a higher to a lower virulence. K. M. Smith and W. D. MacClement described the methods of filtration to obtain the particles, and their measurement. F. C. Bawden described crystalline and liquid crystalline viruses, and J. D. Bernal the structure of the particles. M. A. Watson described the Aphis transmission of some viruses, and P. A. Murphy concluded with an account of the application of the new knowledge to disease control. Not long ago the agent was supposed to be some kind of parasitic organism, but now a new conception has appeared—that of a parasitic substance. A great question is whether to rely on protective inoculation or to produce virus-free stocks. A list of literature ends the paper.

710. Investigations of the Mechanism of the Transmission of Plant Viruses by Insect Vectors—II. By H. H. Storey. (*Proc. Roy. Soc.*, Ser. B. cxxv., **838**, 1938, p. 25. From *Rev. App. Mycol.*, xvii., **6**, June, 1938, p. 386.) Individuals of *Cicadulina mbila*, all capable of acting as vectors of maize streak, varied greatly in ability to cause infection. No plants became infected by any number of punctures if they were all of less than about 5 minutes' duration at temperature ranging from 23° to 26° C. Many punctures of less duration reached the phloem. The hypothesis is advanced that inoculation occurs in distinct doses, each independent in its effect of other doses inoculated by the same or other insects. The delivery of a dose is determined by some incident occurring only after the puncture has been maintained for some time.

[*Cf.* Abstr. **254**, Vol. XI. of this Review.]

GENERAL BOTANY, BREEDING, ETC.

711. Science of the Year 1937: The Biological Sciences. By W. B. Brierley. (Reprint received from the author.) A useful and interesting summary of the work of the year in connection with Human Evolution, Cytogenetics, Zoology, General Physiology, Botany, Microbiology and Disease.

712. Plant Physiology and Agriculture. By H. R. Barnell. (*Trop. Agriculture*, xv., **6**, 1938, p. 123.) A general discussion of problems under the headings of: The assessment of yield; scope and limitations of modern plant physiology; physiology and pathology; complex action of fertilizers; importance of fundamental knowledge.

713. Sur la Vulgarisation des Récents Travaux Concernant la Génétique et Enseignements d'Ordre Pratique à en Tirer. By A. Meunissier. (*Bull. Soc. Nat. Hort. Fr.*, August, 1938, p. 14. From *Pl. Bre. Absts.*, viii., **4**, 1938, p. 334.) A brief review of the basic principles of genetics, simply and clearly

expressed, and their application in explanation of a number of phenomena of practical interest.

714. THE FOUNDATIONS OF MODERN GENETICS ARE QUESTIONED. By N. Platikanov. (*Zemledelie*, Sofia, **41**, 1937, p. 117. From *Pl. Bre. Absts.*, viii., **4**, 1938, p. 337.) A brief outline is given of established genetical theory, followed by an account of the work of Lysenko and collaborators in Russia. This work, it is pointed out, requires verification, firstly on account of the very small number of experimental plants (two in the case of the " transmutation " of Kooperatorka) and secondly, because of the introduction of a new principle—phasic development —said to influence the hereditary nature of the plant. It is expected that such a verification will confirm the general genetical theory, but some part of it, such as the stability of the gene, may be found to require modification.

715. RECENT GENETIC AND BREEDING STUDIES IN COTTON. By J. W. Neely. (*Proc. 38th Ann. Convent. Ass. S. Agr. Wkrs.*, Jackson, Miss., 1938, p. 207. From *Pl. Bre. Absts.*, viii., **4**, 1938, p. 376.) The following lines for future work are suggested: continuing the well-established selection programmes, which have produced most of the improved strains; exhaustive study of intraspecific inheritance; study of the inheritance of interspecific crosses; extensive and systematic crosses between varieties, between New World species and between Old and New World species and, finally, the use of the back-cross method.

716. THE DISCOVERY OF THE RELATION BETWEEN THE NUCLEOLUS AND THE CHROMOSOMES. By R. R. Gates. (*Cytologia*, Fujii Jubilee Vol., Tokyo, 1936, p. 977. From *Pl. Bre. Absts.*, viii., **4**, 1938, p. 338.) The historical development of the theory relating nucleoli to the satellite chromosomes is traced. The author suggests that there are two kinds of satellites, those in connection with which the nucleolus arises and those which take no direct part in nucleolus formation. When an organism has more than one pair of the first type it is probably due to polyploidy. It is possible that subterminal centromeres have been mistaken sometimes for satellites of the second type.

717. A STUDY OF THE EFFECT OF POLLEN UPON THE LENGTH OF COTTON FIBRES. By E. H. Pressley. (*Tech. Bull. No.* 70, Univ. of Arizona, 1937.) The writer considers that as the limit of improvement in yield is approached, the uniformity of that yield will become of greater importance, so that it is necessary to know what characters are heritable. If plant selections are to be made on the basis of the uniformity of the lint, and if crossing with other types of cotton will influence directly the percentage of lint in the shorter classes as indicated by Harrison's results, the practice of selecting plants that have been open-pollinated may lead the cotton breeder into considerable difficulty.

Reciprocal crosses between Delfos and Red Acala and between Pima and Red Acala showed little significant difference in length of fibre, nor were the seeds significantly heavier. In all cases the longer and heavier lint was produced on the same seeds, and with one exception on the heavier seeds (and in this case the difference in weight was not significant).

718. A HERITABLE CASE OF FEMALE STERILITY IN *Herbaceum* COTTON. By C. Vijayaraghavan *et al.* (*Madras Agr. J.*, **24**, 1936, p. 365. From *Pl. Bre. Absts.*, viii., **4**, 1938, p. 323.) The type of female sterility described in an article previously reviewed is found to be due to a single recessive factor, *stg*. Pollen placed on the short style apparently fails to germinate.

[*Cf.* Abstr. **293**, Vol. XII. of this Review.]

719. COTTON LEAF: LOCALIZATION OF SALTS. By V. S. Shardakov. (*C. r. Acad. Sci. U.R.S.S.*, **16**, 1937, p. 431. From *Summ. of Curr. Lit.*, xviii., **9**, 1938,

p. 268.) In cotton leaves, accumulation of K and Cl occurs in the epidermis, glandular hairs, cells lining the oil glands, and nectaries. In saline soils additional small accumulations occur in the chlorophyll-bearing parenchyma and in the guard cells of stomata.

720. METABOLISM IN THE COTTON PLANT. By C. H. Wadleigh. (*49th Ann. Rpt. of S. Car. Exp. Sta.*, 1936-37, p. 35.) Cotton plants were grown in sand culture with a constant flow of nutrient solution, varied as to nitrogen content. Nitrogen was supplied as nitrate at 8, 25, 75, and 225 p.p.m. Plants grown with 8 p.p.m. of N. matured only 4-5 bolls; with 25 p.p.m. of N 11 to 13 bolls; in each treatment after these early bolls set, abscission of all other young bolls took place. Plants grown with 75 p.p.m. of N matured, on the average, 19 bolls at time of harvest on October 10. At this time the plants also carried some 30 developing bolls as well as many squares. These plants were 7½ feet high. Plants supplied with 225 p.p.m. of N matured on the average 23 bolls per plant up to time of harvest on October 12, and also carried 32 developing bolls and many squares. The plants were 8 to 9 feet in height; there was appreciably more abscission of young bolls on them than on the plants receiving 75 p.p.m. of N.

721. NOTES ON THE APPEARANCE AND BEHAVIOUR OF A PECULIAR NEW STRAIN OF COTTON. By J. R. Cotton. (*Proc. 37th Ann. Convent. Ass. S. Agr. Wkrs.*, Jackson, Miss., 1936, p. 57. From *Pl. Bre. Absts.*, viii., 4, 1938, p. 376.) A description is given of an aberrant plant which appeared in 1930 in a block of Express cotton. It had rounded leaves instead of the usual lobed type, and many other unusual features. The progenies raised from it in 1931 and subsequent years bred true to the aberrant type. The normal Upland type is occasionally produced on an aberrant plant as a bud sport, but selfed seed from the Upland branches produces only round-leaved plants which breed true. The aberrant type is believed to be a mutation and is to be studied further. Its somatic chromosome number is 52 or thereabouts.

[*Cf.* Abstr. 722, Vol. XIV. of this Review.]

722. RELATIONSHIPS OF THE CULTIVATED AND WILD COTTONS OF THE WORLD. By T. H. Kearney. (*Proc. 37th Ann. Convent. Ass. S. Agr. Wkrs.*, Jackson, Miss., 1936 (1937), p. 56. From *Pl. Bre. Absts.*, viii., 4, 1938, p. 377.) The difficulties of a satisfactory botanical classification of cottons are emphasized. It is suggested that the cultivated cottons are of hybrid origin, derived from more than one wild species. A system of classification following Harland's in its main outlines is proposed. Three sections of the genus *Gossypium* are recognized: (1) Lint bearing New World species with 26 haploid chromosomes; (*a*) the Mexican-Central American cottons represented by Upland (*G. hirsutum*), (*b*) the South American cottons represented by Sea Island and Egyptian (*G. barbadense*) and the Peruvian tree cottons (*G. peruvianum*), and (*c*) certain species now found wild in Polynesia and the Galapagos Islands, but which may have been cultivated formerly; (2) Old World cottons with 13 haploid chromosomes, (*a*) cultivated Asiatic species, and (*b*) 3 wild species found in South-Eastern Asia, tropical Africa and Australia respectively; (3) Lintless American wild species with 13 haploid chromosomes, comprising 5 species, one in Southern Arizona, three in the Gulf of California region, and one in the Galapagos Islands.

723. HYPOTHÈSES SUR L'ORIGINE ET LES MIGRATIONS DES COTONNIERS CULTIVÉS ET NOTES SUR LES COTONNIERS SAUVAGES. By G. Roberty. (*Candollea*, vii. Geneva, 1938, p. 297.) The author groups all the cultivated cottons round the following nine species: (A) Old World: *Gossypium arboreum*, L., *Nanking*, Mey., *herbaceum*, L., and *obtusifolium*, Roxb.; (B) New World: *Gossypium hirsutum*, L., *purpurascens*, Poir., *barbadense*, L., *peruvianum*, Cav., and *brasiliense*, Macf.

These groups are morphologically and cytologically distinct, and the author does not consider that true and lasting hydridization is possible.

In his summary he states that the haploid Old World cottons, with campanulate flowers and basally united bracts, form a homogeneous group with two species, *G. arboreum*, L., and *G. obtusifolium*, Roxb., naturally fixed, the other two artificially. The diploid cottons of the New World, with infundibuliform flowers and free bracts, have been produced by hybridization of wild species belonging to two groups, Hawaii-Californian, and Galapagos-Andine-Antillean. But the author distinguishes in the group the five primitive species given above, though the rules that guide their hybridization are not yet properly made out.

The publication is furnished with several diagrams, a bibliography of some 58 names, and an index of the scientific names of the various species of the genus *Gossypium*.

724. Contribucion a la Lucha Mecanica contra Algunos Enemigos del Algodonero Mediante la Formacion de Variedades Adecuadas. By G. A. Kreibohm de la Vega. (*Rev. Industr. Agr. Tucuman*, **27**, 1937, p. 99. From *Pl. Bre. Absts.*, viii., **4**, 1938, p. 377.) Two new varieties, Sirigi from Alagoas, Brazil, and Hoja Digitada, an Acala from Chaco, are being intercrossed in the attempt to produce a cotton whose flowers and fruits are free from enclosing leaves, thus allowing the direct penetration of arsenical sprays used in combating various insect pests.

725. Recent Work on Photoperiodism in Plants. By A. E. Murneek. (*Missouri Sta. Res. Bull.* 268, 1937. From *Exp. Sta. Rec.*, 78, **4**, 1938, p. 461.) A review of developments during the past five or six years, with 39 references to the literature.

726. On Plant Growth Hormones. By F. Kögl. (*J. Soc. Chem. Ind., Lond.*, lvii., **3**, 1938, p. 49. From *Rev. App. Mycol.*, xvii., **6**, June, 1938, p. 409.) In connection with a general review of recent developments in the utilization of plant growth hormones in medicine, chemistry, and botany, the writer briefly summarizes the results of his experiments (in collaboration with N. Fries) on the application of biotin, inositol, and aneurin as stimulants to fungal growth.

727. Aneurin and the Rooting of Cuttings. By F. W. Went *et al.* (*Sci.*, **87**, No. 2251, 1938, p. 170.) Aneurin, the root growth hormone, if applied at the appropriate time after roots have been initiated by auxin, greatly increases the root development of cuttings.

FIBRES, YARNS, SPINNING, WEAVING, ETC.

728. The Classification of Cotton. (*Misc. Pubn. No.* 310, *U.S. Dept. of Agr., Washington, D.C.*, May, 1938.) A very good standard account of the classification of cotton prepared by the Bureau of Agricultural Economics, giving information on the following: Nature and basis of classification; sampling; factors of and standards for grade; determination of grade; method of grading irregular and special-condition cotton; inaccuracies in grading cotton; factors of and the standards for staple; method of stapling; effect of moisture on staple and character; relation of classification to prices, etc. The pamphlet is well furnished with illustrations.

729. Industrial Fibres. (Printed and pubd. for the Imperial Economic Committee by H.M. Stat. Off., 1938. Price 2s. 6d. net, 2s. 9d. post free.) A summary of figures of production, trade and consumption, relating to cotton, wool, mohair, silk, flax, jute, hemp, and rayon, compiled in the Intelligence

Branch of the Imperial Economic Committee. In connection with cotton, statistics are given of acreage, unit yield, production, cotton varieties, stocks, exports, imports, mill consumption, and prices, from 1930 to 1937.

730. OBSERVATIONS ON THE STRUCTURE OF COTTON FIBRES IN THE DARK FIELD. By B. Babinowitsch. (*Contrib. Boyce Thompson Inst.*, viii., 5, 1937. From *Exp. Sta. Rec.*, 78, 4, 1938, p. 467.) Using *Gossypium hirsutum* with fibres at 7-55 days after blossoming, the cellulose particles occurred predominantly as uncombined units in the young fibres, but with increasing age chains of particles were formed. Microscopic mounts of chemically treated commercial fibres showed the reverse process of wall formation, with all stages of membrane layers disintegrating into fibrils, and these, in turn, into cellulose particles.

731. A DEVICE FOR DETERMINING THE PROPORTION BY WEIGHT OF FIBRES OF DIFFERENT LENGTH IN A SAMPLE OF COTTON. By N. Ahmad and C. Nanjundayya. (*Tech. Bull. Ser. B, No.* 23, Ind. Cent. Cott. Comm., 1938.) The cotton stapling apparatus designed at the Technological Laboratory (Bombay) some time ago gives the mean length and weight per unit length of a cotton. It, however, suffers from the limitation that it does not give the frequency distribution of length, a knowledge of which is often useful, not only to the research worker, but also to the trade and industry. With a view to remedying this deficiency a new attachment to the stapling apparatus has now been designed. The description and mode of operation of the device are given in this paper. Further, the results of experiments, conducted with a view to determining the degree of agreement with the other instruments in vogue, are also given. It is shown that this device is capable of yielding consistent results which agree well with those given by the Balls Sorter.

[*Cf.* Abstr. 345, Vol. XIV. of this Review.]

732. THE ORIGIN OF LINT AND FUZZ HAIRS OF COTTON. By A. G. Lang. (*J. Agr. Res.*, 56, 7, 1938, p. 507.) The time and origin of lint and fuzz hairs on the ovules of six selected varieties of cotton have been studied. The hairs in all varieties were found to have an essentially similar developmental history. In the King Naked variety most of the lint fibres originate on the day of flowering, and additional lint may differentiate during the next 2, 3, or 4 days. In Cleveland Fuzzy Tip, lint initials differentiate in abundance on the day after flowering, and others make their appearance in the following 3 or 4 days. Fuzz fibres originate continuously at the micropylar end of the ovule from about the sixth to the eleventh day. In Mexican 128-6, hairs that are presumably the lint initials appear in abundance in the day of flowering and during the next 3 or 4 days in areas near the micropylar end of the ovule. Hairs that presumably give rise to fuzz originate on about the fourth day after flowering, and continue to arise for a period of 3 or 4 days. In Nankeen lint, hairs believed to be the lint initials differentiate from the epidermal cells on the day of flowering and continue to form in the region of the micropyle for the next 4 or 5 days. Hairs believed to be the fuzz initials first appear in abundance on the sixth day after flowering, and continue to originate for a period of about 5 or more days. In Sea Island, almost all of the lint fibres originate on the second day after flowering, but a small number of others may arise on the following 2 or 3 days. The fuzz initials arise on about the seventh, eighth, and ninth days after flowering. In Sakel × Pima, hairs that are presumably the lint initials appear on the day after flowering, and a few others develop during the next 3 or 4 days. The fuzz at the micropylar end of the seed originates between the fifth and tenth days after flowering. The fuzz on other portions of the seed apparently begins to develop on about the eighth day after the flower opens. It is suggested that lint hairs originate when or soon after the cotton flower opens, and that the first fuzz hairs

appear only after the lint population has been fully determined. It is further shown that this thesis is consistent with the results of other investigators.

733. Studies in the Variation of Strength and Weight per Inch with Group Length of Cotton Fibres. By C. Nanjundayya and N. Ahmad. (*Tech. Bull. Ser. B, No.* 24, Ind. Cent. Cott. Comm., 1938.) For the experiments a representative sample of cotton was fractionated into its constituent group lengths with a Baer sorter. The breaking load of whole fibres was determined with a Balls' magazine hair tester, modified in some respects. Of the nine cottons selected to cover a wide range of fibre properties, seven were standard Indian cottons and two exotic varieties. Successive lengths differing by ⅛ inch were tested for Nandyal 14, while for the remaining cottons, the alternate groups differing by ¼ inch were tested. The following, among other conclusions, are presented:

The mean breaking load decreases with an increase in group length; the range of variation between the longest and the shortest groups being 39 to 128 per cent. in different cottons. The frequency distributions, which are generally asymmetrical and skew, indicate a large preponderance of weak fibres in each group length. Nearly 90 per cent. of the fibres in the longest groups have breaking load below 3·9 gms. The coefficient of variation for all group lengths in a cotton is of the same order (60-65 per cent.) as that obtained by the previous workers for the unsorted sample, but the long staple cottons show greater irregularity specially in the shortest lengths. The effect of increasing the mean length of a cotton as in breeding by about 2·7 per cent., is to decrease its mean fibre strength by 12·5 per cent. Regarding the variation of fibre weight per inch with different group lengths, it is found that: (*a*) the fibre weight per inch decreases with an increase in group length, except for the two longest cottons, which have very nearly constant fibre weight per inch in the different group lengths; and Nandyal 14, which behaves in a somewhat erratic fashion. (*b*) In conformity with Iyengar and Turner's observation, *Hirsutum* cottons have smaller fibre weight per inch in the longer group lengths, while the *Indicum* cottons do not show this feature to an appreciable extent: the *Herbaceum* cottons show larger variations than those observed by Iyengar and Turner.

734. Identification of Crystalline Cellulose in Young Cotton Fibres by X-Ray Diffraction Analysis. By W. A. Sisson. (*Contrib. Boyce Thompson Inst.*, viii., 5, 1937. From *Exp. Sta. Rec.*, 78, 4, 1938, p. 467.) Cotton fibres 5-50 days old were subjected to X-ray diffraction analysis, samples consisting of fresh and preserved untreated fibres, fibres after chloroform extraction, and those after further purification with 1 per cent. NaOH and 2 per cent. sodium hypochloride. Crystalline cellulose was indicated at about 30-35 days in the untreated fibres, at 15-20 days in the extracted, and as early as 5 days in the purified fibres. The cellulose pattern was not present in the X-ray diagram of the first group, being masked by a crystalline "wax pattern" (removable by dilute alkalies and bleaching). The crystallographic identity of the cellulose from the young purified fibres to that of mature cellulose is shown by its identical unit cell dimensions and by the fact that the native X-ray pattern may be changed to a mercerized pattern. The observations of Farr and Eckerson are confirmed, in that cellulose is first formed in the cytoplasm as crystalline cellulose particles. After cellulose is once formed it does not undergo a crystalline modification during fibre growth.

735. Fibres: Clinging Power and Friction. By O. Schmidhauser and R. Stoll. (*Klepzig's Textil Z.*, 41, 1938, p. 103. From *Summ. of Curr. Lit.*, xviii., 8, 1938, p. 236.) The influence of structure, especially surface structure,

fineness, flexibility and other characteristics of textile fibres on their clinging power is discussed. The influence of clinging power in textile processes is pointed out and various attempts to measure it are critically reviewed. A method based on measurements of the frictional resistance on drawing out a bundle of fibres, starting from a state of rest, is described. The tuft of fibres is pressed between clamp jaws which are provided with a fixed lining of fibres of the type being tested. The jaws are pressed together, by means of a suitable lever system, with a pressure which can be varied as required. A load is applied to the fibre tuft and is increased until the tuft is drawn out. The load at this moment is a measure of the frictional resistance between the fibre tuft and the fibre linings of the clamp jaws. The results of tests on wool, cotton and staple fibres with various pressures between the jaws are shown in the form of frictional resistance-pressure curves. As the pressure increases the curves change into straight lines, which, if extended, do not in general pass through the origin, but cut the frictional resistance axis. This effect is attributed to the influence of fibre structure, curl, etc., and is most apparent in the case of wool and smallest in the case of staple fibres. Expressions are deduced for the coefficient of friction, the coefficient of friction for fibre of *l*-denier fineness, and a corrected coefficient of friction which is comparable with the coefficient of friction as defined in mechanics. The values for the different fibres are compared. The effects of humidity, mercerization, dyeing, etc., on fibre-on-fibre frictional resistance, handle and flexibility and on behaviour in processing are briefly discussed.

736. Textile Fibres: Moisture Relations. By W. G. Schaposchnikov. (*Sbirnik Inst. Akad. Nauk, U.R.S.S.*, 3, 1937, p. 119. From *Summ. of Curr. Lit.*, xviii., 7, 1938, p. 205.) Observations on the moisture absorption and desorption of vegetable, animal, and artificial fibres, extending over several months, are said not to give any evidence of hysteresis.

737. Raw Cotton, Mercerized Cotton and Rayon: Moisture Relations. By W. G. Schaposchnikov and W. A. Lepetov. (*Sbirnik Inst. Chem. Techn., Akad. Nauk U.R.S.S.*, 5, 1937, p. 89. From *Summ. of Curr. Lit.*, xviii., 9, 1938, p. 265.) In the "air-dry" state, raw cotton (C), mercerized cotton (M), and rayon (R), prepared from the same cellulose contained 6·80, 9·78 and 12·60 per cent. of moisture respectively; in a saturated atmosphere the values were 13·69, 20·54, and 24·95 per cent. The time required to reach equilibrium in the saturated air was (C) 167·5, (M) 185·5, and (R) 220 hours. The mean time required for the uptake of 1 per cent. of moisture (from the slope of the curves) was (C) 24·31, (M) 17·22, and (R) 17·90 hours, but the difference in rate of regain between cotton and rayon was more striking in the initial period from zero to the air-dry state. Here cotton required 4·88 hours to increase by 1 per cent., but rayon required 13·17 hours.

738. Raw Cotton: Moisture Regain. By W. G. Schaposchnikov. (*Sbirnik Inst. Chem. Tech., Akad. Nauk U.R.S.S.*, 5, 1937, p. 3. From *Summ. of Curr. Lit.*, xviii., 9, 1938, p. 265.) The author investigated the moisture content of more than 50 samples of cotton from different localities and in different seasons, and found that the wide scatter of values became much closer when the specimen was cleaned and prepared by hand. He ascribes this to the levelling influence of the heat of the hand of the observer.

739. Stream-Lined Air Current Cotton Opening and Cleaning Machine. British Cotton Industry Research Asscn. (Manchester). By T. C. Williams and S. A. Shorter. (B.P. 483,653, 22/10/36, 22/4/38. From *Summ. of Curr. Lit.*, xviii., 11, 1938, p. 310.) A machine for the opening and cleaning of cotton or similar fibrous material has a spiked or saw-toothed beater which strikes the

material from feed mechanism into a stream of air entering by an inlet duct rearwards in the machine, an upper boundary wall terminating at a point near the place of entry of the material, and a lower boundary wall joining the rear wall of a settling chamber having a forward end wall concave or shaped in cross-section to the interior of the settling chamber to provide a "knee" below the beater surface and rearward of its most forward point, and fashioned and continued forward of the knee to produce in conjunction with the beater a gradually convergent channel. For the purpose of ensuring a determinate air stream downwards and forwards the upper boundary wall may merge into a cross-rail adjacent the beater. A lower feed roller of small diameter resting in cup bearings spaced on the cross-rail and an upper feed roller of small diameter weighted by a large diameter roller resting on it may be used. An adjustable member may be provided on the cross-rail and a curved streamer plate, preferably of crescent shape, may be located adjacent the beater and fitting closely to it above the "knee" and located over the forward part of the settling chamber and co-operating with a converging boundary plate forward of the knee. A channel for the further conveyance of the material may be provided by a forward continuation of the lower boundary wall of the channel and by an upper deflecting plate either fixed or adjustable, such channel directing the material to a cage or cages. Lap-forming mechanism may follow the cage or cages.

740. Cotton Proteins: Influence in Bleaching Processes. By E. Kornreich. (*Textilberichte*, **19**, 1938, p. 61. From *J. Text. Inst.*, xxix., **4**, 1938, A215.) On treatment of cotton with alkali under pressure, the proteins in the cotton pass into colloidal solution in the alkali and increase the emulsifying power of the latter. Complete removal of the proteins in this process is, however, hindered by the absorptive power of cellulose for colloidal substances. In chlorine bleaching processes, cotton proteins are converted to chloramines which have bleaching and oxidizing powers. Alkali dissolves them and concentrated alkali converts them to forms not giving active chlorine reactions. In acid solutions the chloramines are precipitated and fixed on the fibre, and in this state are difficult to decompose and also retain a certain amount of absorbed acid. In alkaline hydrogen peroxide solutions, cotton proteins are dissolved and bleached, and they exert a stabilizing action on the peroxide solution. In the scour-chlorine bleach combination most of the proteins are removed in the scouring process and chloramines are only formed to a small extent in the chlorine bleaching operation. In the chlorine-peroxide bleaching process, the chloramines formed in the chlorine treatment are dissolved by the alkaline hydrogen peroxide, and react with the latter at high temperatures. The chloramines also have a stabilizing action on hydrogen peroxide solutions. Cotton proteins are almost completely removed by a scour-chlorine-peroxide bleaching treatment, and this is the best method of purification.

741. Influence of Twist on Yarn Strength. By N. Ahmad and V. Venkataraman. (Conf. of Res. Workers on Cotton in India, 1937. From *Mnthly. Bull. of Agr. Sci. and Practice*, Rome, April, 1938, 161T.) A report of tests carried out to study the influence of twist on yarn strength and to find, if possible, the optimum twist constant for selected Indian cottons covering a wide range of staple length, extending from short-stapled Oomra to the long-stapled Sind Sea Island cotton. Conclusions are drawn from the results of the tests regarding yarn breakages, yarn evenness and lea strength.

742. Preparing Cotton Yarns for Weaving. By I. W. Barker. (*Text. Rec.*, June, 1938, p. 23.) A discussion of the winding and reeling operations.

TRADE, PRICES, NEW USES.

743. World Trade Commodities: Their Sources and Uses. VII. Cotton: A Plant that Clothes the World. (*Man. Guar. Coml.*, 27/5/38, p. 482.) A good popular article describing the plant, countries where grown, marketing, spinning, etc.

744. Relation of Fertilization and Selling Price to Profitableness in Cotton Production. By C. B. Williams. (*N. Car. Sta. Bull.* 313, 1937. From *Exp. Sta. Rec.*, 78, 5, 1938, p. 707.) "Without fertilizing, when the selling price of seed cotton (seed and lint) is no higher than 2·5 ct. per pound, its growth will usually be done at a considerable loss on the dominant Coastal Plain and Piedmont soils of North Carolina, the least loss occurring on those more productive soils of the Marlboro, Greenville, Norfolk, and Ruston sandy loam types. With fertilization, the selling price of seed cotton being 2·5 ct. per pound, the growth of cotton is usually done at less than cost of production. With typical soils of the Coastal Plain and Piedmont regions used in cotton growing, the most profitable applications are usually the ones varying from 600 to 1,200 lb. per acre of suitable fertilizer mixtures, provided the selling price of cotton is equivalent to 5 ct. or more per pound for seed cotton. Cotton grown on Marlboro, Greenville, Ruston and Norfolk sandy loams in a fairly high state of productiveness gave greater net returns from fertilization, both at 5 and 8 ct. a pound for seed cotton, than when grown on the same and other types of soil in a less productive state."

745. Relation of Spot Cotton Prices to Prices of Futures Contracts, and the Protection Afforded by Trading in Futures. By L. D. Howell and L. J. Watson. (*Bull. No.* 602, U.S. Dpt. of Agr. Washington, D.C. From *Text. Wkly.*, 27/5/38 and 3/6/38.) The objectives of the study were: To show the relationship between prices of spot cotton and prices of futures contracts; to determine to what extent futures trading affords protection from changes in prices of spot cotton by offsetting the risks from price changes through hedging transactions; to indicate the influence of various factors on the spot-futures-price relationship and protection afforded by futures as hedges; to indicate the effects of trading in futures on fluctuations in prices of spot cotton, and to give some indications of the effects of trading in futures on prices to producers.

746. Proposed U.K.-U.S.A. Trade Agreement: American Cotton Textile Industry's Point of View. By Dr. C. T. Murchison. (*Text. Wkly.*, 8/4/38, p. 471.) Voicing the objections upon the basis of the much higher costs in the U.S.A. where wages alone are 145 per cent. higher than in Britain.

747. New Giza 7 Contract in Liverpool. (*Cotton*, M/c, 2/7/38, p. 4.) A new future delivery contract for Giza 7 grown in Egypt and Sakellaridis grown in Egypt, also Sakellaridis or similar varieties grown in the Sudan, was adopted at an extraordinary meeting of the Liverpool Cotton Association held on June 23 last. Trading in this new contract commenced on July 1, 1938, for delivery in January, 1939, and onwards. As regards the existing Giza 7 future delivery contract, no further months of delivery will be quoted after June, 1939, and trading in that contract will cease on June 30, 1939. Only the following growths may be tendered: Giza 7 or Sakellaridis grown in Egypt, and Sakellaridis or similar varieties grown in the Sudan. The existing Giza 7 contract is now to be described as the No. 1 Giza contract, and the new contract as the No. 2 Giza contract.

PERSONAL NOTES

APPOINTMENTS

Mr. S. G. Stevens has been appointed by the Corporation as an Assistant Geneticist at the Cotton Research Station, Trinidad.

OFFICERS ON LEAVE

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes " home " on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the time of writing the following officers are on leave, or will shortly be arriving, in this country from cotton-growing countries:

British Guiana	Mr. F. Burnett.
Ceylon	Mr. F. P. Jepson.
"	Dr. P. C. Sarbadhikari.
Gold Coast	Mr. A. D. T. Montagu.
Kenya Colony	Mr. C. O. Oates.
" "	Mr. C. L. Silvester.
" "	Mr. H. Wolfe.
Nigeria	Mr. J. R. Brown.
"	Dr. G. Bryce.
"	Mr. G. F. Clay.
"	Captain W. B. Dowson.
"	Mr. M. W. Gibbon.
"	Mr. F. D. Golding.
"	Mr. G. L. Herington.
"	Mr. E. T. Holmes.
"	Mr. E. W. Leach.
"	Mr. J. K. Mayo.
"	Mr. E. W. Momber.
"	Mr. A. F. W. Sheffield.
"	Mr. W. A. Watson.
"	Mr. J. West.
Nyasaland	Mr. C. Smee.
Sierra Leone	Dr. F. J. Martin.

Sudan	Mr. W. L. P. Cameron.
"	Dr. F. Crowther.
"	Mr. H. E. King.
"	Mr. G. F. March.
"	Mr. R. T. Paterson.
"	Mr. W. Ross.
Tanganyika Territory	Mr. L. R. Doughty.
" "	Mr. T. Marshall.
" "	Mr. J. Robertson.
" "	Mr. F. R. Sanders.
Uganda	Mr. C. G. Hansford.
"	Dr. W. S. Martin.
"	Mr. G. B. Masefield.
"	Mr. G. W. Nye.
"	Mr. A. S. Richardson.
West Indies: *Trinidad*	Mr. G. A. Jones.
"	Mr. F. J. Pound.
"	Mr. F. Stell.

The following officers of the Corporation's staff abroad are on leave in this country:

Nyasaland	Mr. H. C. Ducker.
West Indies	Mr. S. H. Evelyn.

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